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WINTERING BALD EAGLE STUDIES IN NEW MEXICO, 1979

Report Compiled by:

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Rocky Mountain Forest and Range Experiment Station

Tempe, Arizona

In fulfillment of an Interagency Agreement with:

Bureau of Land Management

New Mexico State Office

Santa Fe, New Mexico

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INTRODUCTION

This report is an assembly of several bald eagle (Haliaeetus leucocephalus) studies fully or partially funded by the Bureau of Land Management (BLM) in New Mexico. Through an Interagency Agreement, the Rocky Mountain Forest and Range Experiment Station (RMS) was responsible for conducting a portion of the research, administering the funds, and compiling this report.

Each study that follows is presented in its original, complete form. Any references taken from this composite report should be keyed to the individual works. Citations or other use of this unpublished material require authorization from the funding and/or administrating agencies. The order of presentation is as follows:

Navajo Lake

Chama River - Santa Fe National Forest study

Gila River - Gila National Forest study

Aerial Surveys

Nesting Activity

The first three comprise the major, intensive study effort on wintering eagles. The aerial survey information came directly from the New Mexico Department of Game and Fish, while the nesting section includes accounts of the southwestern New Mexico and Animas River, Colorado, sites.

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Table 1 shows the distribution of funds received by the RMS from the BLM for bald eagle studies in New Mexico. Not indicated because they were paid by the respective agency are the salaries and support services of RMS and New Mexico Game & Fish personnel, and the contribution of the Gila and Santa Fe Forests to the contracts in their areas. Both these Forests had winter study plans underway prior to the RMS and BLM agreement; thus, the figures indicated in Table 1 do not represent the total contract costs in these areas but only the extent of BLM funding through the RMS Cooperative Agreement. The Gila and Santa Fe administered their respective contracts.

Table 2 outlines the field personnel involved in this cooperative bald eagle study. Blair, Jakle, and Roberts are full-time, permanent RMS technicians. Luckett and Dodd are private individuals contracted to perform their respective studies. Falxa, Lanning, Ukrain, and Whitacre are field biologists of the Chihauhaun Desert Research Institute, an organization frequently contracted in the past for peregrine falcon studies in New Mexico. The Skaggs have worked both for CDRI and as private contractors. In addition to the above personnel, Forest biologists Art Renfro (Carson NF), Bruce Anderson (Gila NF), and Leon Fisher/Keith Giezentanner (Santa Fe NF) were involved in planning, coordinating, arranging support services, and establishing priorities in their respective areas. John Hubbard, Endangered Species Program, performed similar functions with the New Mexico Game & Fish Department in arranging statewide aerial surveys.

Table 1. - Distribution of the $47,000 BLM Interagency Agreement funding for bald eagle studies in New Mexico during 1978 - 1979.

Agency	Purpose	Location	Amount
Rocky Mountain Station	overhead	-	$ 11,750
	ground studies	Navajo L.	15,700
	nest surveillance	Centerfire Bog.	1,000
Carson National Forest	aerial surveys	Navajo L.	5,000
Santa Fe National Forest	aerial surveys	Chama R.	4,300
	ground studies		
Gila National Forest	aerial surveys	Gila R. &	4,000
	ground studies	vicinity	
New Mexico Game & Fish	aerial surveys	statewide	5,250

Table 2. - Personnel involved in winter bald eagle field studies during 1978 - 1979.

Administrating Agency	Location	Personnel	Affiliation
Rocky Mountain Station	Navajo L.	Teryl Grubb	RMS
		Steve Blair	RMS
		Marty Jakle	RMS
		Dave Roberts	RMS
	Centerfire Bog.	Bill Luckett	Private
Santa Fe National Forest	Chama R.	Norris Dodd	Private
Gila National Forest	Gila R. & vicinity	Gary Falxa	CDRI[1]
		Dirk Lanning	
		Kate Skaggs	
		Roger Skaggs	
		Devora Ukrain	
		David Whitacre	

[1] Chihauhaun Desert Research Institute, Alpine, Texas.

NAVAJO LAKE

BALD EAGLE USE OF NAVAJO LAKE

DURING THE WINTER OF 1979

Teryl G. Grubb

U.S. Forest Service

Rocky Mountain Forest and Range Experiment Station

Tempe, Arizona

In partial fulfillment of an Interagency Agreement with:

Bureau of Land Management

New Mexico State Office

Santa Fe, New Mexico

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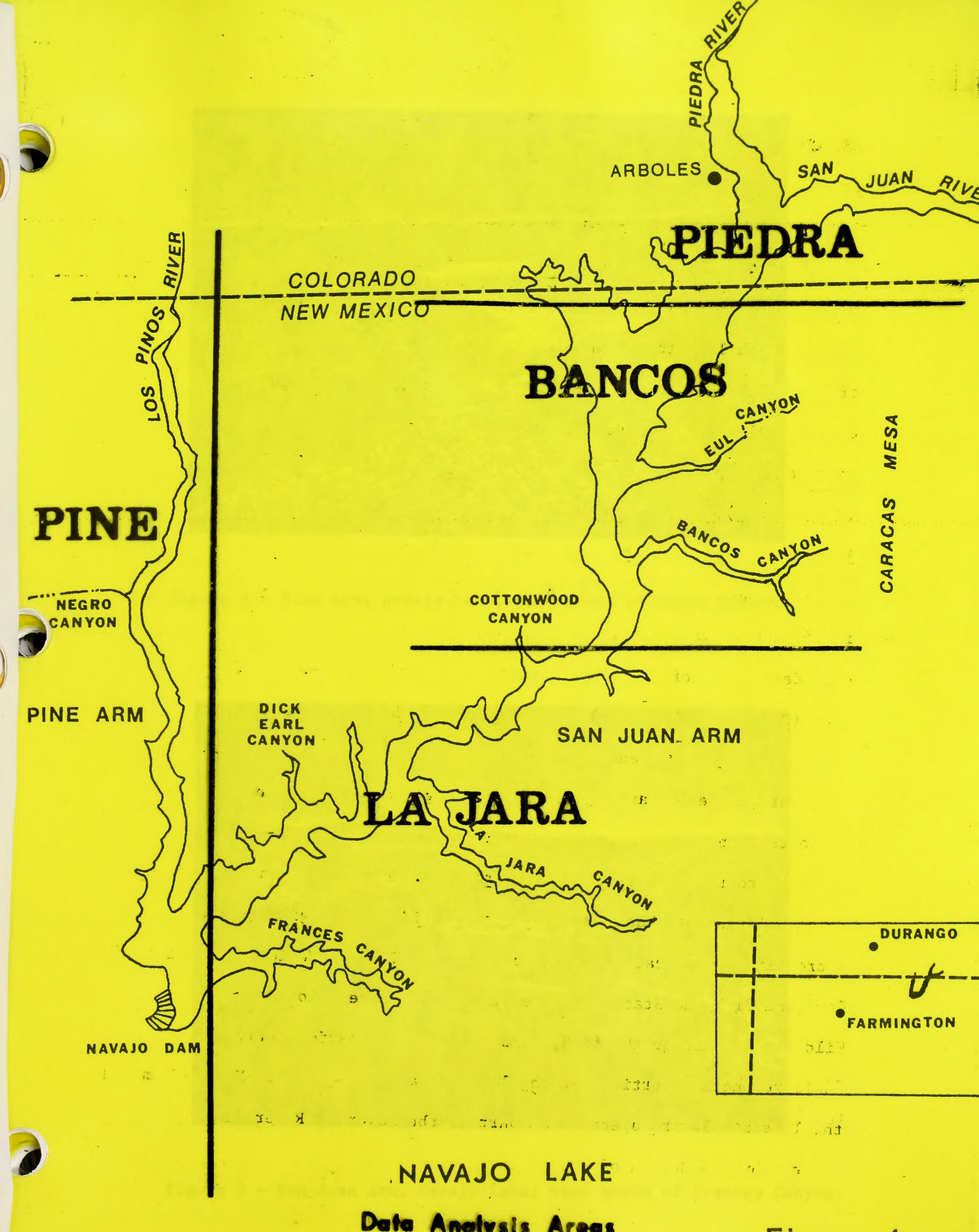
INTRODUCTION

Through recent coordinated efforts of numerous state and federal agencies, including the Bureau of Land Management (BLM), the U.S. Forest Service (USFS), the Fish and Wildlife Service (FWS), the New Mexico Department of Game and Fish, and the Navajo Nation, several hundred bald eagles have been consistently recorded wintering in New Mexico. During a USFS study conducted by the Rocky Mountain Forest and Range Experiment Station (RMS) in 1978, a winter concentration of an estimated 30-50 eagles was located at Navajo Lake in northern New Mexico. Because of the proximity of the Carson National Forest and the surrounding BLM ownership, this study was arranged as part of an Interagency Agreement to better define numbers and distribution of the bald eagles in the area and to determine their winter habitat needs for roosting, loafing, and foraging activities.

METHODS

Study Area

Navajo Lake is a V-shaped reservoir crossing the Colorado-New Mexico border east of Durango and Farmington (Figures 1-3). The lake is the main storage area for an extensive irrigation project on the Navajo Nation which lies to the west. The Bureau of Reclamation began construction of the earth and rock dam in 1958; the structure was completed in 1962. Geologically, the San Juan River valley with its sedimentary sandstone and shale is part of the Wasatch Formation of the Eocene age. Cottonwood (Populus sp.), willow (Salix sp.), tamarisk (Tamarix gallica), Utah juniper (Juniperus utahensis), and pinyon pine (Pinus edulis) grow along the lake shore, while scattered ponderosa pine (P. ponderosa) and Douglas fir (Pseudotsuga menziesii) occur at higher elevations. The area is considered part of the pinyon-juniper habitat type. An abundance of mule deer (Odocoileus hemionus), elk (Cervus canadensis), rabbits (Sylvilagus sp., Lepus californicus), and a variety of waterfowl (see Food Habits section for listing) reside around the lake during the winter. Navajo Lake supports both warm and cold water fisheries in the form of brown and rainbow trout (Salmo trutta, S. gairdneri), Kokanee salmon (Oncorhynchus nerka), largemouth bass (Micropterus salmoides), bluegill (Leponis macrochirus), and catfish (Ictalurus sp.). The New Mexico Department of Game and Fish and State Parks Commission, and the Colorado Division of Wildlife administer the fish, wildlife, and recreation activities on their respective portions of the lake and adjacent lands. Navajo Dam and the lake itself are operated as part of the Colorado River Storage Project by the Bureau of Reclamation.



Data Analysis Areas

Figure 1

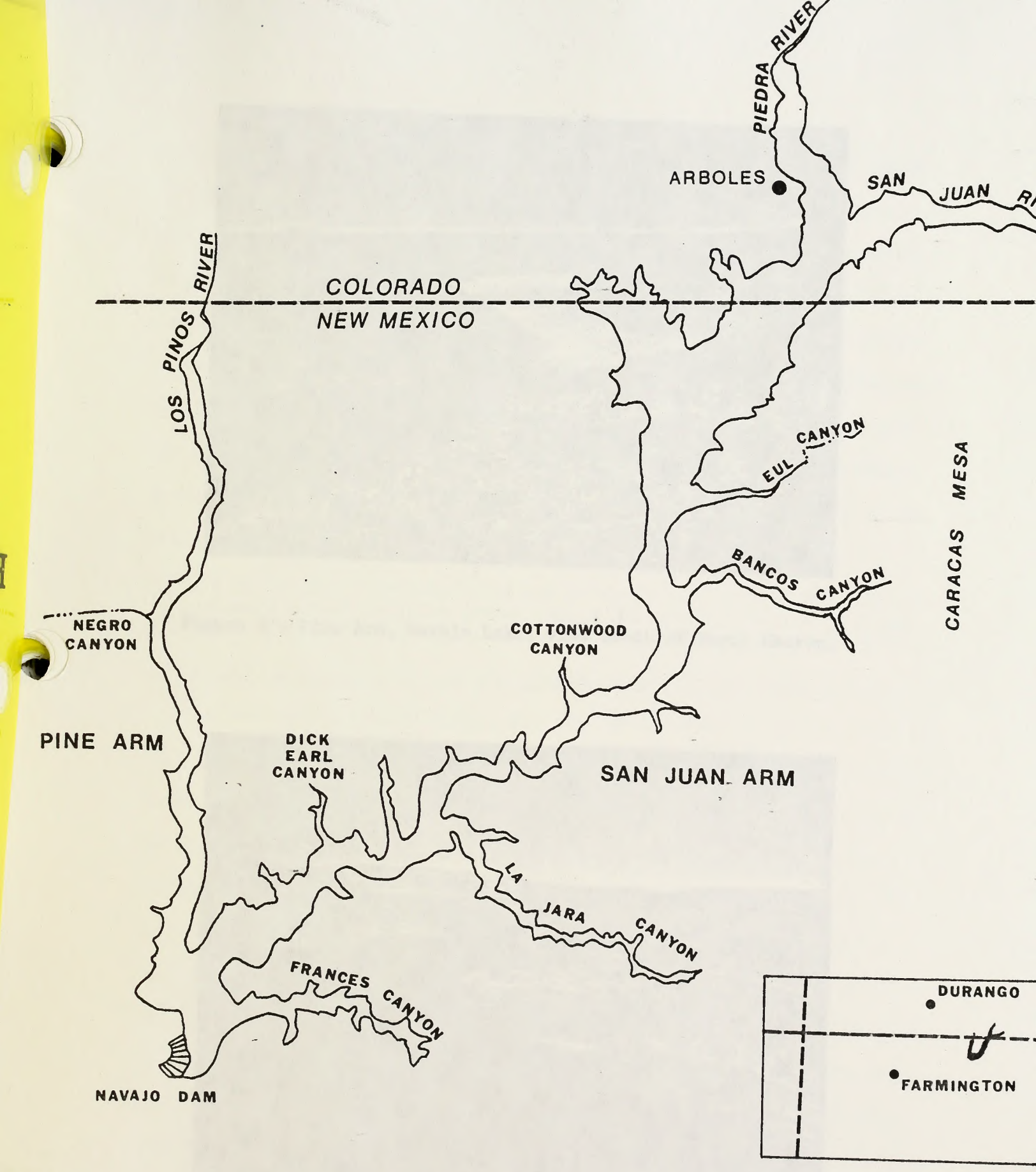
PIEDRA

BANCOS

PINE

LA JARA

Data Analysis Areas



NAVAJO LAKE

Figure 1

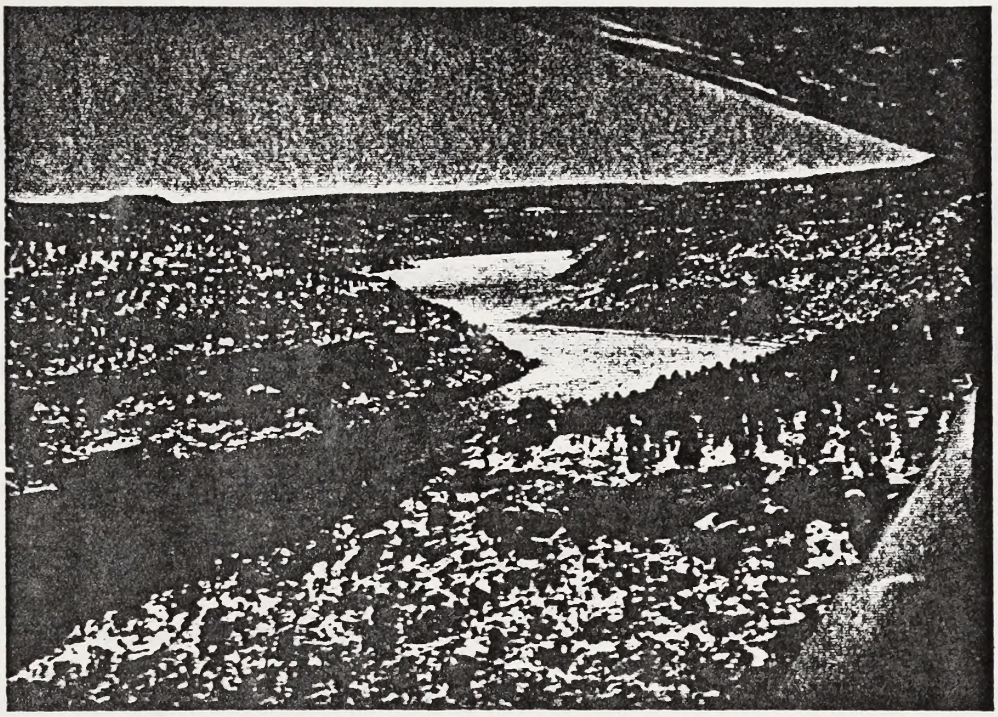


Figure 2 - Pine Arm, Navajo Lake; view south of Negro Canyon.

Figure 3 - San Juan Arm, Navajo Lake; view north of Frances Canyon.

Study Period and Personnel

Winter bald eagle research was conducted at Navajo Lake by RMS personnel from 8 January through 10 April 1979. Three permanent technicians (Steve Blair, Marty Jakle, Dave Roberts) and the author alternated schedules, with a minimum of two personnel involved in all field operations. Quarters were maintained through most of the study at a motel in Arboles, Colorado. Table 1 summarizes the periods of field study and aerial survey dates.

Table 1. - Study periods and aerial survey dates at Navajo Lake by RMS personnel between 8 January and 10 April 1979.

Field study periods:	8 - 19 Jan
	22 Jan - 2 Feb
	5 - 16 Feb
	20 - 23 Feb
	3 - 10 Apr
Aerial survey dates:	12, 24, 30 Jan
	6, 13, 20 Feb
	6, 13, 27 Mar
	9 Apr

Aerial Coverage

In addition to the dates shown in Table 1, the New Mexico Department of Game and Fish also flew Navajo Lake and vicinity on 30 November 1978, 23 January and 24 April 1979 in a twin engine Cessna Skymaster (C-337, push-pull configuration). RMS flights were conducted from both a single engine Cessna (C-206) fixed-wing aircraft and a Bell (47G-3B1) helicopter. Federal regulations (BLM, USFS) do not permit flight in a single engine aircraft below 500 feet above ground level (AGL), while the normal slow operating speed for the Skymaster is about 100-120 mph and for the C-206, about 90-100 mph. Both factors greatly reduced the effectiveness of fixed-wing flights. Ideally, bald eagles should be surveyed from 100-200 AGL at 60-80 mph, or even slower if possible. The helicopter easily and safely met those criteria, and was therefore used as much as possible.

As per usual, timing, dates, and type of aircraft on the flights were subject to scheduling conflicts and weather conditions; thus, the weekly flights planned were not always possible. Because of the size of Navajo Lake, aerial surveys provided the best indication of population numbers. However, since variations in aircraft, pilots, observers, weather conditions, time of day, etc., all influence survey counts, the numbers of eagles tabulated cannot be considered absolute. The helicopter flights are felt to be the most accurate, with an estimated accounting of 85-95% of the population present. Fixed-wing surveys, particularly with the type of aircraft used, are probably 10-20% less thorough. At least two observers were present on all survey flights. Sightings were recorded on maps and either described on tape or in abbreviated field notes. Concentration areas, prey distribution, ice patterns and roosting habitat were also noted from the air.

Ground Coverage

Efforts were initially concentrated wherever groups of eagles occurred. Binoculars and spotting scopes were used throughout the study to monitor birds until patterns of activity or movement became evident. Where access was possible, such as at the northern end of the San Juan Arm, eagles were surveyed and observed from a 4-wheel drive pickup. These efforts were supplemented by hiking or snow shoeing to good vantage points to determine activity and habitat use. Roosts were located in most cases by observing the time and direction of late afternoon flights, then subsequently stationing one person at the staging or loafing area and the remaining one or two personnel at intervals along the apparent route taken. Hand-held radios made deployment of field personnel to separate vantage points both feasible and effective. Flying eagles could often be monitored from one position to the next. Occasionally, it was possible to follow flying eagles by driving along an adjacent section of road. The keys to successful definition of activity patterns and habitat use from ground observation were positioning and patience.

Boating Observations

A 14-foot aluminum boat and 20 hp outboard motor were used to negotiate Navajo Lake itself. The boat allowed access to such areas as Bancos, Eul, La Jara, and Frances Canyons, as well as providing a versatile observation station and a means of surveying the shoreline. It was essentially the only means of accessing the Pine Arm. As with the pickup, it was occasionally possible to follow a flying eagle; but the inherent bias of continued flight being caused by the moving boat reduced the validity of such observations. Access to the lake and areas of eagle use was often

limited by ice. Wind, rough water, and cold also affected observations. The boat was regularly used for transportation to areas where ground observation points were established. Occasionally one or more observers were put ashore to monitor a group of eagles, while the remaining shoreline was surveyed from the boat. Radio contact was again invaluable for such operations.

Data Recording

A master field notebook of daily personnel and eagle activities was maintained throughout the study. Eagle sightings were recorded each day on both maps (BLM, .5 inch = 1 mile) and on sighting forms (Appendix I). Each sighting was categorized by age (adult, immature, unknown) and identified by time and location (legal description). Weather data and activity were also noted. Although the age class of subadults was noted according to Servheen (1975) and Southern (1964) whenever possible, only adult-immature categories were used on field forms and subsequent analyses because of variations in observer experience and inherent limitations in techniques such as aerial surveys. For use at roost sites, the habitat evaluation form included in Appendix I was developed from a field form (also included) originated for the 1977-78 Forest Service study (Grubb 1978). A portable tape recorder proved useful for field recording of sighting and activity information, but the cold often reduced battery life and effective operation. Location of deer and elk carcasses and the progression of ice on the lake were also documented in the field notes and on maps. Following the field study, data from the sighting forms were punched on computer cards for subsequent manipulation and analysis. To reduce bias the study area was divided into four regions,

each representing a normal day's field coverage: Piedra, Bancos, La Jara, and Pine (Figure 1). The aerial flights were grouped as a fifth data subset for population analyses, since all aerial surveys covered the entire lake and study area.

RESULTS AND DISCUSSION

Population Numbers and Distributions

The minimum wintering population of bald eagles at Navajo Lake, as documented by aerial surveys, varied from 15 to 77 between November 1978 and April 1979, when apparently all eagles were gone from the area (Table 2). The average number of eagles present during the January to April study period was about 35-40. Only the 12 January survey was incomplete due to bad weather at the north end of the San Juan Arm. As mentioned previously, because of the size and inaccessibility of the lake, aerial surveys were the only means of determining total population. Thus the figures in Table 2 must be considered minimums rather than representing absolute population size.

The population peaked (77 eagles) in late January and again in late March (57 eagles) (Figure 4). The March high may indicate pre-migratory staging activity, while the midwinter high in January is typical of wintering populations across the country (Spencer 1976). Separate peaks through the winter have been noted elsewhere in response to variations in weather conditions, prey availability, and migratory patterns (Servheen 1975, Shea 1973, Southern 1963). As shown in the figure, these peaks fell on either side of the maximum ice build-up on the lake. The ice curve is approximated from a plot of field observations, but it

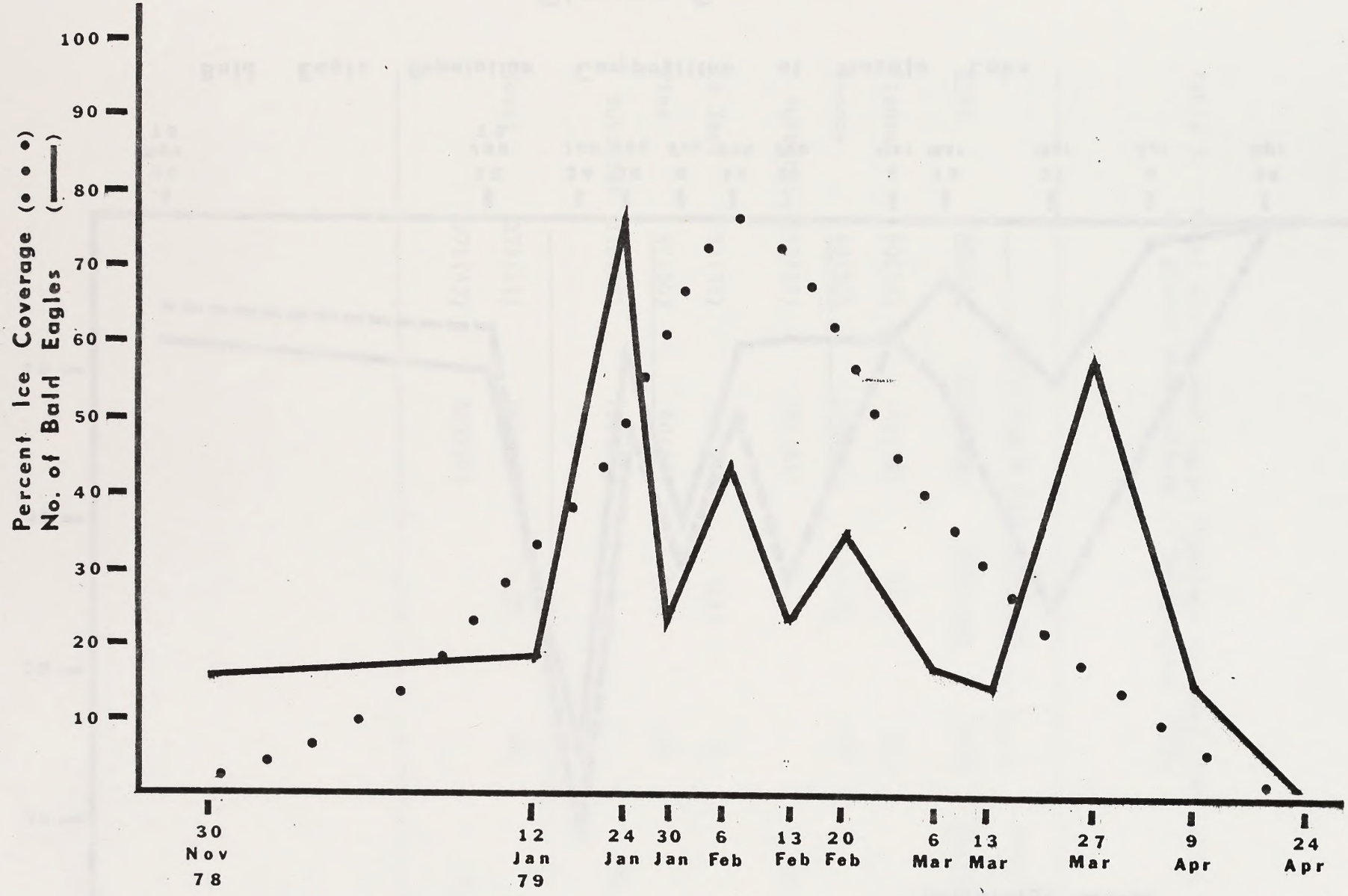
is a direct manifestation of winter weather conditions (Appendix II). The eagle population peaked when the lake was 60-70% open in both January and March, suggesting a direct relationship to the open water possibly through prey availability. The relationships may be more subtle with prey acting secondarily to the severity of weather conditions, which probably drive a number of eagles from the area at the same time the lake freezes. The amount of ice on the lake may merely reflect the weather patterns that are dictating more general bald eagle wintering and migratory movements. From a South Dakota study, Steenhof (1976) has hypothesized that air temperatures and wind affect the number and distribution of eagles, respectively, while prey availability affects both. The relative position of the population peaks and the ice curve suggest a rapid departure during the period of coldest temperatures just prior to maximum ice coverage but a lag in population buildup following temperature moderation and increased open water.

Because of the variation in fixed-wing versus helicopter surveys and the consecutive flight dates, the 23 January fixed-wing flight is not included in the plot of Figure 4, prior to the 24 January helicopter survey which documented a greater number eagles at Navajo Lake. However, it is interesting to note that 20 bald eagles (17A, 3I) were counted on the Animas River on the earlier flight, bringing the total to within 12 of the next day's lake count. Although this drainage was not flown on the 24th, the possibility is worth mentioning that the two surveys may have documented a group movement similar to those evidenced in Utah by Edwards (1969). He observed 35-38% increases in a winter population of 84 eagles in less than a week. Unfortunately, it is equally possible that the two flights merely demonstrated the disparity between techniques.

Table 2. - Results of bald eagle aerial surveys at Navajo Lake during the winter of 1979. Flights starred (*) were conducted by the New Mexico Department of Game and Fish, all others were performed by RMS personnel.

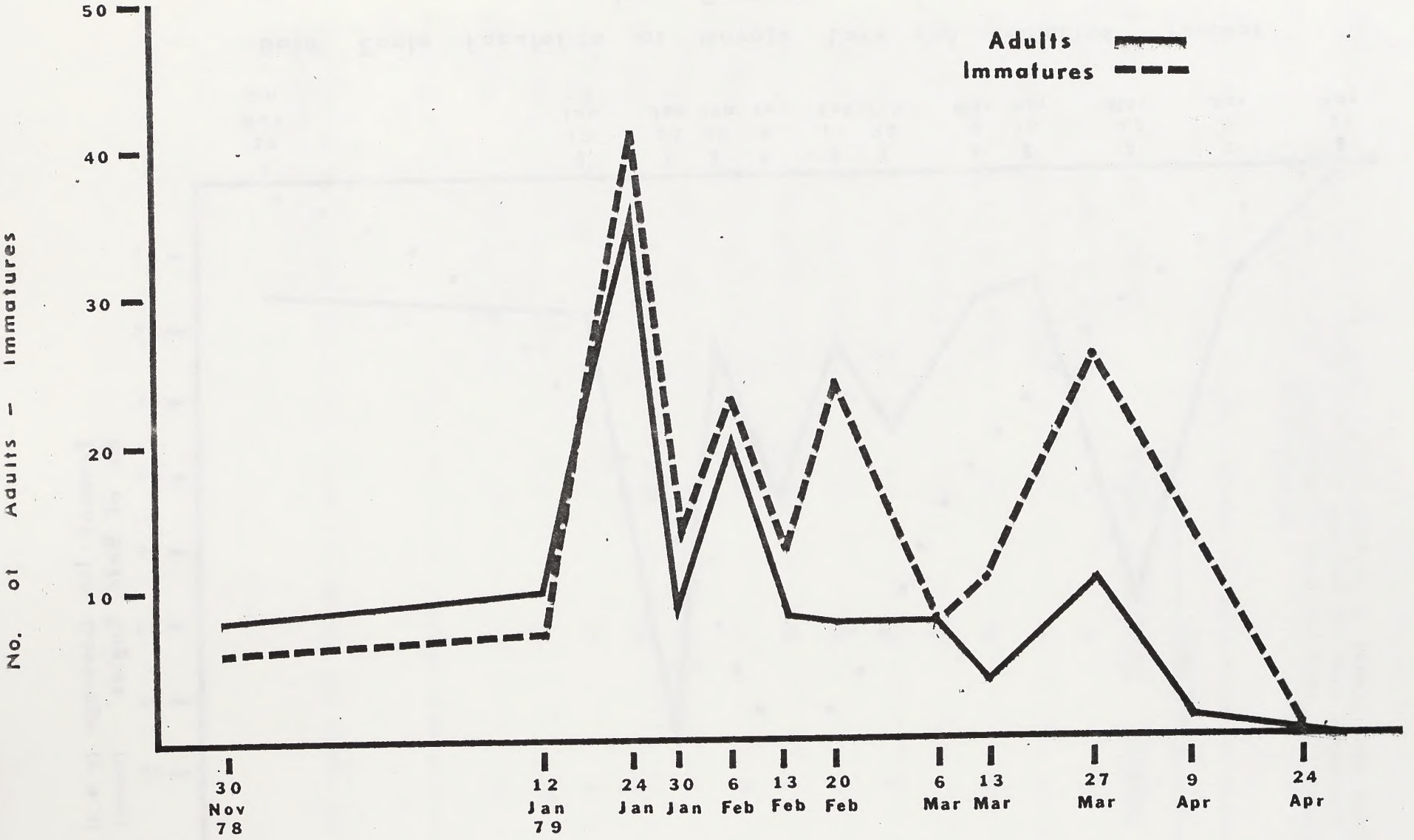
		Bald Eagles			
Date	Type Aircraft	Adults	Immatures	Unknowns	Total
*30 Nov 78	Fixed-wing (C-337)	8	6	1	15
12 Jan 79[1]	Fixed-wing (C-206)	10	7	1	18
*23 Jan	Fixed-wing (C-337)	24	19	0	43
24 Jan	Helicopter (B-1)	35	41	1	77
30 Jan	Fixed-wing (C-206)	9	14	1	24
6 Feb	Helicopter (B-1)	20	23	1	44
13 Feb	Fixed-wing (C-206)	9	13	1	23
20 Feb	Fixed-wing (C-206)	8	24	3	35
6 Mar	Fixed-wing (C-206)	8	8	1	17
13 Mar	Fixed-wing (C-206)	4	11	0	15
27 Mar	Helicopter (B-1)	21	36	0	57
9 Apr	Helicopter (B-1)	1	14	0	15
*24 Apr	Fixed-wing (C-206)	0	0	0	0

[1]Piedra-San Juan River confluence, north of Arboles, not flown due to deteriorating weather.



Bald Eagle Population at Navajo Lake and Estimated Percent Ice Coverage

Figure 4



Bald Eagle Population Composition at Navajo Lake

Figure 5

Table 3. - Total winter bald eagle sightings recorded from aerial surveys and ground observations at Navajo Lake, 1979.

	Bald Eagle Sightings (%)				Combined A:I
Area	Adults	Immatures	Unknowns	Total	Ratio (Approx.)
Piedra	90(38)	141(59)	9(4)	240	
Bancos	63(32)	120(61)	14(7)	197	
Subtotal	153(37)	261(63)			40:60
La Jara	51(53)	44(46)	1(1)	96	
Pine	67(50)	60(44)	8(6)	135	
Subtotal	118(53)	104(47)			50:50
Total	271(41)	365(55)	32(5)	668	
	271(43)	365(57)			40:60

Table 4. - A breakdown of bald eagle aerial sightings in each of the four areas of Navajo Lake during 1979.[1] (A = adults, I = immatures, U = unknowns, T = Total)

	Piedra				Bancos				La Jara				Pine			
Date	A	I	U	T	A	I	U	T	A	I	U	T	A	I	U	T
12 Jan	0	0	0	0	3	3	0	6	0	1	0	1	5	3	1	9
24 Jan	5	11	0	16	7	13	1	21	13	7	0	20	6	4	0	10
30 Jan	1	3	0	4	5	7	1	13	3	3	0	6	0	1	0	1
6 Feb	1	2	0	3	3	7	1	11	5	3	0	8	8	5	0	13
13 Feb	2	1	0	3	1	7	0	8	4	3	0	7	2	2	0	4
20 Feb	3	1	0	4	1	14	1	16	4	3	1	8	0	6	1	7
6 Mar	0	0	0	0	1	3	1	5	5	4	0	9	2	1	0	3
13 Mar	1	0	0	1	0	3	0	3	2	8	0	10	1	0	0	1
27 Mar	4	12	0	16	10	17	0	27	5	4	0	9	0	1	0	1
9 Apr	1	5	0	6	0	8	0	8	0	0	0	0	0	0	0	0
Total Sightings	18	35	0	53	31	82	5	118	41	36	1	78	24	23	2	49

Most Abundant Age Class	Number of Flights			
A	3	0	6	5
I	5	9	2	3
A = I	0	1	1	1

[1] Due to problems in coding field data for computerization, the above flight information will not equal the figures given in Table 1 for every case; however, the trends and ratios evidenced are accurate representations of field observations.

Figure 5, shown at twice the vertical scale of Figure 4 to provide better data separation, displays the numbers of adult and immature eagles recorded on aerial surveys. Despite the lack of coverage in December, the data evidence a trend of adults arriving and departing this wintering area prior to immatures. Through January and most of February adult and immature numbers were about equal, but by last week of February adult numbers noticeably decreased. (Contrary to what one might expect, these variations in age structure were not as obvious in the field as through later data analysis, primarily because of the numbers of eagles involved and the large area under surveillance.) In Utah adults also preceed immatures into and out of the wintering area (Edwards 1969); however, the pattern varies around the country. In the northwest, adults arrive first but both age groups leave simultaneously (Servheen 1975, Stalmaster et al. 1979). Through the interior states of the midwest an early subadult arrival prevails (Ingram 1965; Southern 1963, 1964; Sprunt and Ligas 1966; Steenhof 1976). These authors also indicate that immatures winter further south, which would help explain their high proportion in the Navajo Lake population.

The ratios of adults to immatures, expressed as percentages, are developed in Table 3 for different portions of the lake as well as for the whole population. Overall, a 40:60 adult-immature ratio was observed during the winter of 1979. With the exception of the Skagit River in Washington where 53% immatures were observed (Servheen 1975), this high percentage differs markedly from the more typical 30% figures of other parts of Washington (Hancock 1964, Stalmaster et al. 1979), Utah (Edwards 1969), Montana (McClelland 1973) and South Dakota (Steenhof 1976). The

two areas at the north and east portion of the lake provided the basis for the apparent preponderance of immatures, while the La Jara-Pine areas showed a more nearly 50:50 ratio. The total flight sightings in Table 4 substantiate these ratios, while the number of flights showing the most abundant age class suggest an increased number of adults in the south and west portions of the lake. These variations may reflect a more plentiful or concentrated prey base along the north and east portions of the lake. More immatures are typically found in such situations (Grubb 1978, Southern 1963, Stalmaster 1976). Similarly an overall prey abundance at Navajo Lake could be working with the geographic southern extreme of the winter range to account for the high proportion of immatures.

To illustrate the general distribution and areas of consistent or high use for wintering bald eagles, an index was developed using the whole number product of 1) the percent of days in an area eagles were seen in a given section by 2) the percent of total area sightings seen in that section. Appendix III provides a complete listing for each area and section where sightings occurred. The indices thus developed were used to portray population distribution in Figure 6A. Both numbers and consistency of use are represented in this figure; however, some bias still remains. The number of sightings in concentration or high use areas grew exponentially since observation efforts increased proportionally to the number of eagles present. It is also assumed that all sections within an area were equally surveyed on each of the days spent in that area. Nevertheless the sighting data in Figure 6A, along with Table 3, do provide a good indication of population distribution and composition.

Roosts (as described under a later section) were located in each of the Piedra, Bancos, and Pine areas (Figure 6B). Both casting material collected and aerial survey observations (Table 4) indicate the Bancos area was the most consistently utilized by the largest number of eagles (up to 27 on 27 March). Through the study period, slightly more birds were seen from the air in the Piedra area than Pine, but evidence at the roosts showed greater use in the Pine area. Possibly eagles roosting in Negro Canyon ranged further during the day. Aerial sightings in the La Jara area ranked second, but ground observations of both birds and casting evidence showed this area to be the least important of the four. Perhaps again, eagles spending the day in this portion of the lake roost in either the Pine or Bancos areas.

In addition to the Navajo Lake data discussed above, there were 42 sightings of eagles in more upland habitat on 28 separate occasions between January and March (Table 5). These sightings were made from the highways around the lake or between Arboles, Farmington, and Durango. Occasional sightings were also made from survey aircraft in transit to or from the lake. The San Juan River from the dam to Farmington, the Animas and Florida Rivers below Durango, and approximately 10-15 miles of the Los Pinos, Piedra, and upper San Juan Rivers were all flown thoroughly at least once, and more frequently as time, weather, and survey routes permitted. Although the sightings thus recorded are insufficient to define the size or distribution of any riverine or terrestrial dwelling winter population, they do suggest rather limited, widely scattered numbers.

It is interesting to note 19 of the 28 observations were of lone birds, while 8 were of two. On only one occasion were more than two eagles observed together, when two adults and five immatures were seen in the vicinity of a livestock dump near Ignacio. Overall, 26 sightings were adults with 14 immature and 2 unknowns (Table 5). The less visible nature of the immatures may account for part of this disparity in adult-immature numbers, but it is also possible the experienced adults are better suited to the more demanding, variable nature of terrestrial feeding. The larger proportion of immatures present in the Ignacio area may be related to the close proximity of that area to Navajo Lake itself. Some of the lake population could be ranging out over surrounding areas during the day or even for more extended periods of time. The dispersal of wintering eagles into adjoining upland habitat as weather and prey vary has been noticed in numerous studies, best summarized by Spencer (1976); while the tendency of immatures to congregate near abundant food has already been mentioned.

Table 5. - Winter bald eagle sightings away from the Navajo Lake study area, January-March, 1979. (A = adults, I = immatures, U = unknowns, T = Total)

Location	No. Times Eagles Sighted	Total Bald Eagle Sightings A	I	U	T
Ignacio, southeast	13	11	9	2	22
Los Pinos River	3	3	1		
Durango, southeast	8	9	2	0	11
Animas River	3	4			
Florida River	1		1		
near La Plata airfield	4	5	1		
San Juan River	5	5	2	0	7
3-10 mi. below dam	4	4	2		
E. Farmington	1	1			
Upper Piedra River	1	1	0	0	1
W. of Pine Arm	1	0	1	0	1
Totals	28	27	13	2	42

PREY DISTRIBUTION (C)

■ DEER \ ELK CARCASS

WATERFOWL AREA

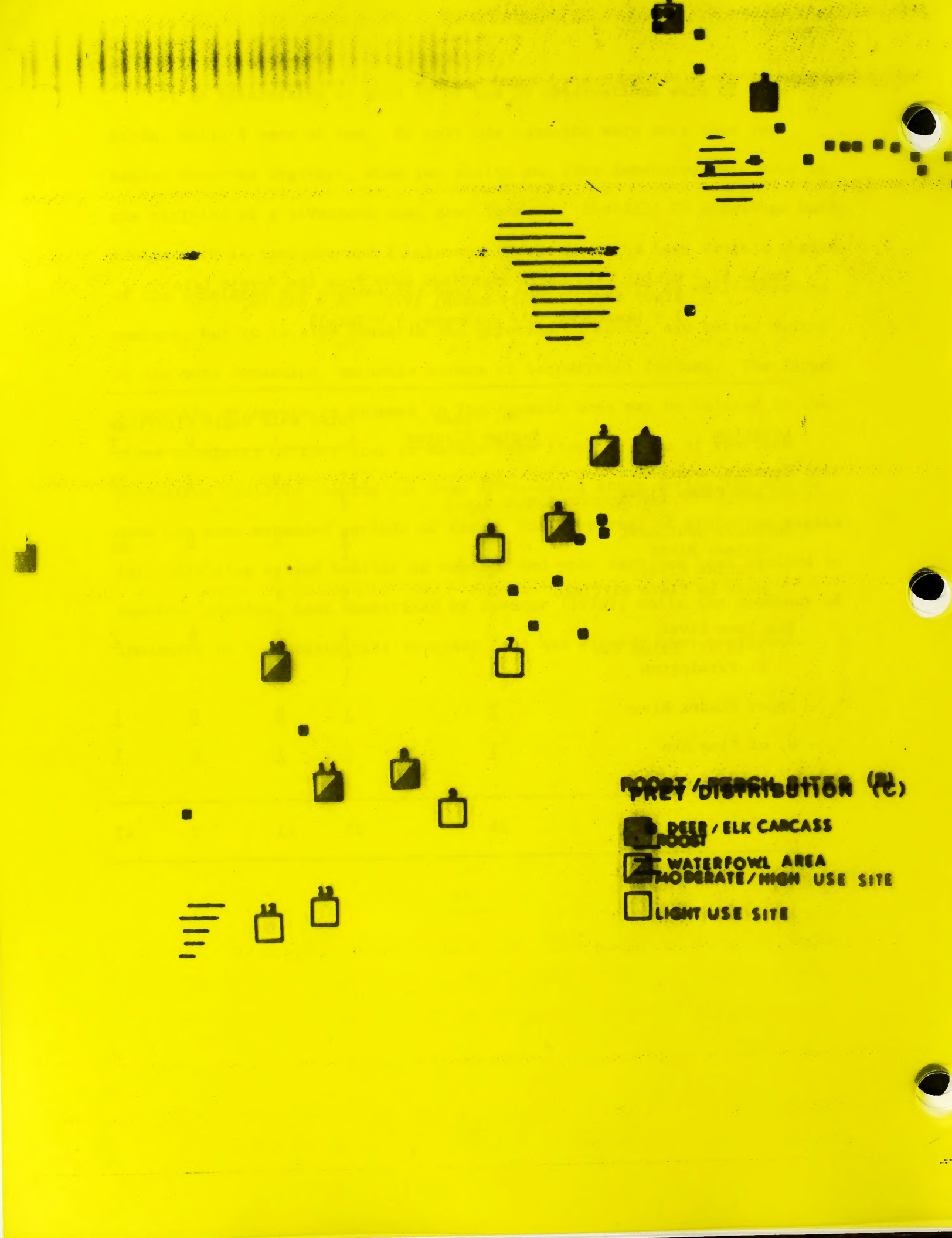
PREY DISTRIBUTION (C)
DEER / ELK CARCASS
WATERFOWL AREA

ROOST / PERCH SITES (B)

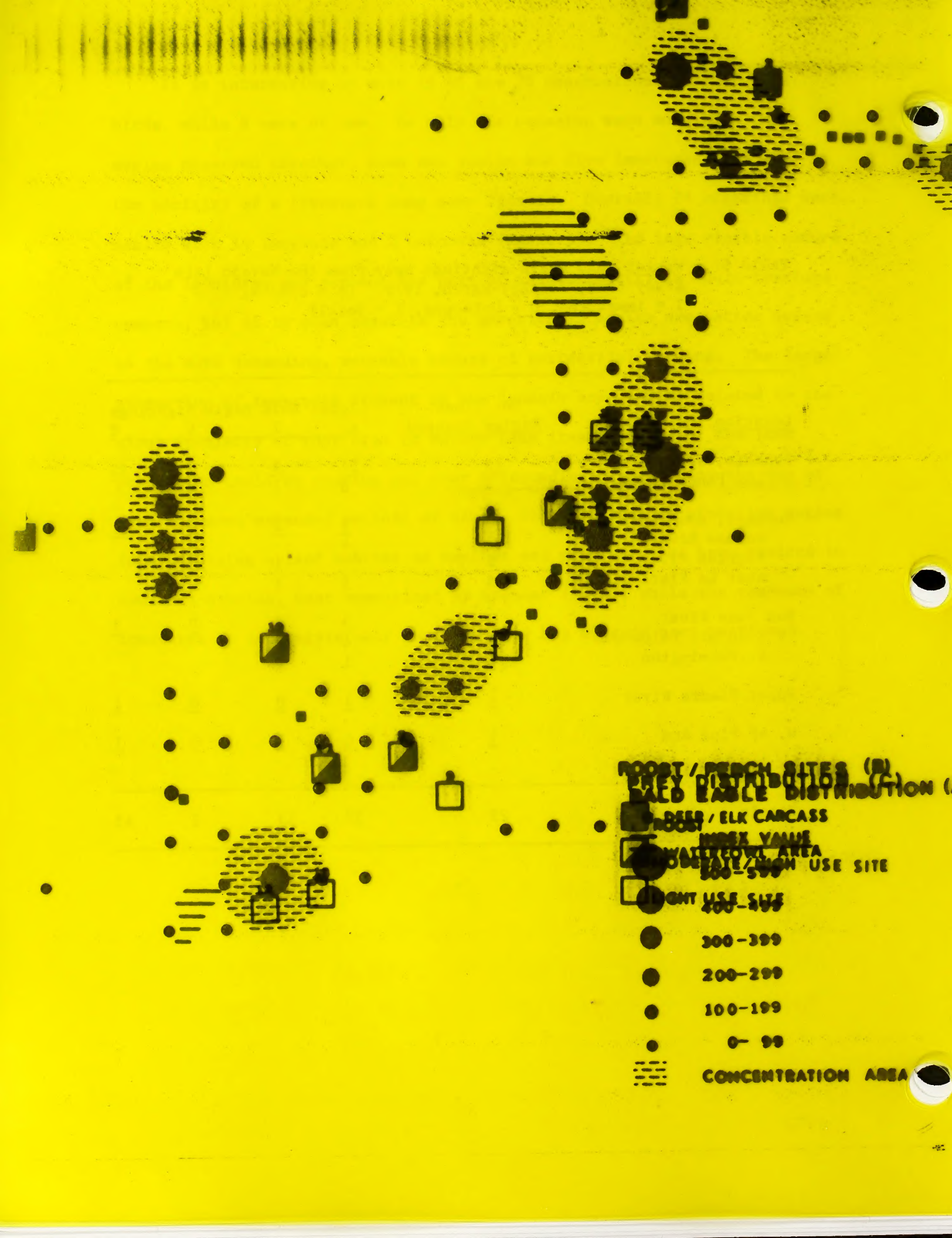
ROOST

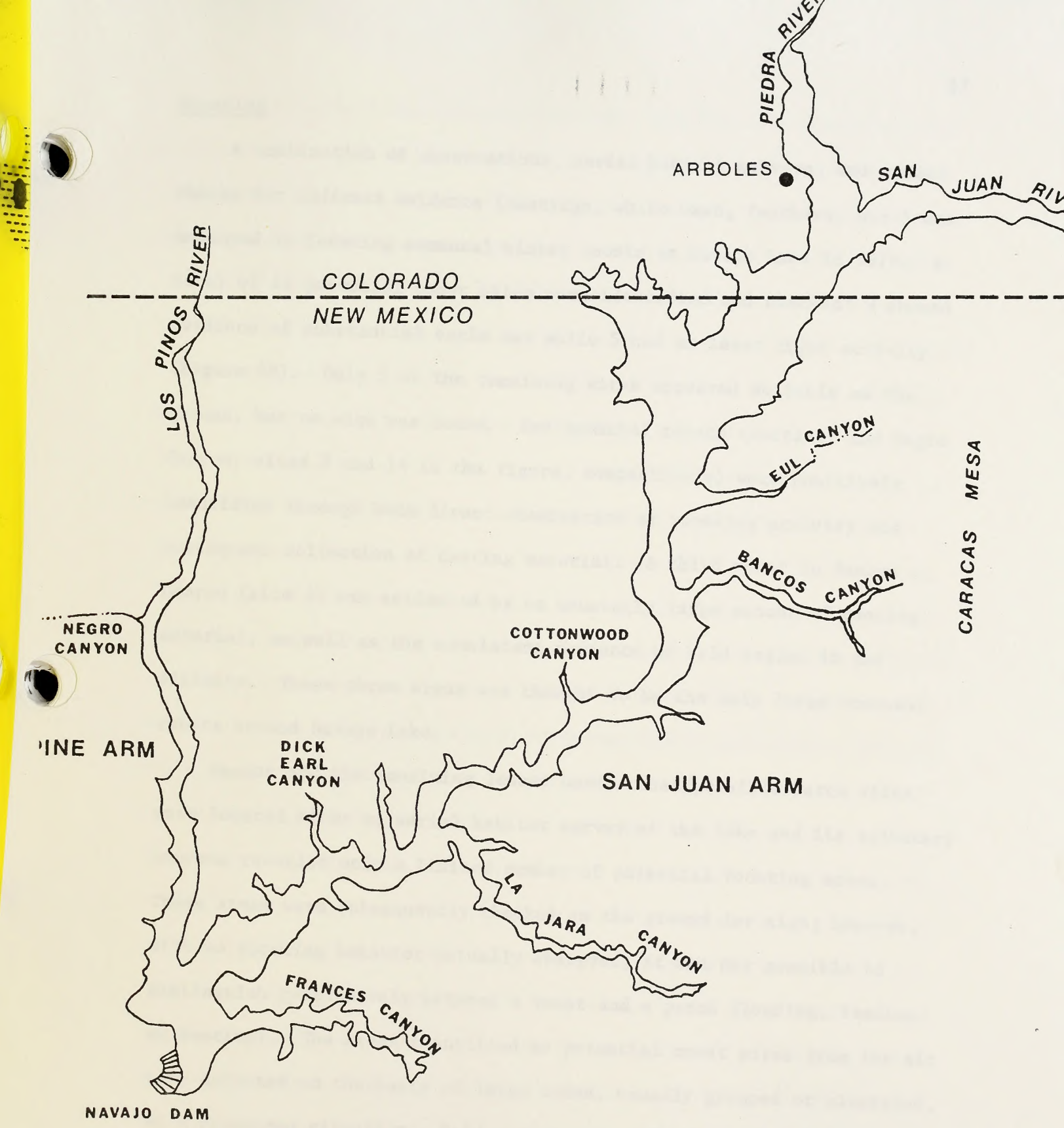
MODERATE / HIGH USE SITE

LIGHT USE SITE


PREY DISTRIBUTION
DEER / ELK CARCASS
WATERFOWL AREA
MODERATE / HIGH USE SITE
LIGHT USE SITE

BALD EAGLE DISTRIBUTION
INDEX VALUE
300-399
400-499
200-299
100-199
0- 99
CONCENTRATION AREA


ROOST / PERCH SITES (B)
PREY DISTRIBUTION (C)
BALD EAGLE DISTRIBUTION (
DEER / ELK CARCASS
ROOST
INDEX VALUE
WATERFOWL AREA
USE SITE
LIGHT USE SITE
300-399
200-299
100-199
0- 99
CONCENTRATION AREA



NAVAJO LAKE

Figure 6

Roosting

A combination of observations, aerial habitat surveys, and ground checks for indirect evidence (castings, white wash, feathers, etc.) was employed in locating communal winter roosts at Navajo Lake in 1979. A total of 24 potential roost sites were identified and checked: 9 showed evidence of substantial eagle use while 5 had at least light activity (Figure 6B). Only 5 of the remaining sites appeared suitable on the ground, but no sign was found. Two communal roosts (Bartlett and Negro Canyon, sites 2 and 14 in the figure, respectively) were positively identified through both direct observation of roosting activity and subsequent collection of casting material. A third roost in Bancos Canyon (site 4) was evidenced by an unusually large amount of casting material, as well as the consistent presence of bald eagles in the vicinity. These three areas are thought to be the only large communal roosts around Navajo Lake.

Bancos and the remaining lesser used, roost/possible perch sites were located after an aerial habitat survey of the lake and its tributary canyons revealed only a limited number of potential roosting areas. These areas were subsequently checked on the ground for sign; however, with no roosting behavior actually observed, it was not possible to distinguish conclusively between a roost and a perch (loafing, feeding, or hunting). The areas identified as potential roost sites from the air were selected on the basis of large trees, usually grouped or clustered, in a protected situation. Bald eagles are probably as variable in their roosting requirements as in other aspects of their natural history; but the factors mentioned seem to comprise the basic criteria for roost selection (Dunstan 1974, Edwards 1969, Stalmaster 1976, Steenhof 1976).

Also it should be noted that there may be other roost (or perch) sites than those delineated in Figure 6B, particularly if they are infrequently used, harbor few birds, and/or are distant from the lake. Grubb (1978), Southern (1964), and Stalmaster (1976) are among the studies documenting wintering eagles roosting singly or in small groups. The numerous isolated ponderosa pine, the scattered, higher elevation Douglas fir along the Pine Arm, and the Piedra and San Juan River valleys with the adjacent upland habitat (including Caracas Mesa) offer numerous riparian or timber roosting possibilities.

Ponderosa pine, Douglas fir, and cottonwood in descending order of importance were the three species of roost trees observed during this study. Ponderosa when available are thought to be more attractive to roosting eagles than Douglas fir because of the large lateral branching and open crowns. In the three communal roosts located, there were usually several roost trees indicated with varying amounts of use. Conceivably as in other areas, tree structure, weather conditions, habitual use, and/or intraspecific competition establish primary and secondary or peripheral roost trees in a stand (Dunstan 1974, Edwards 1976, Lish 1975, Ingram 1965). The number of roost trees varied from one to several, apparently independent of the stand size. High-use trees were usually among the largest in the stand and located in the lower portions of the drainages. Rather surprisingly, snags were well represented among the apparent roosts; but the trend to live, foliated trees during portions of the season was still indicated. There was no apparent relationship between exposure (aspect) and roost location at Navajo Lake.

Both observations of birds during the day and physical evidence, such as large prey remains, suggest some daytime use of night roost areas which is again typical (Edwards 1969, Spencer 1976). Evening movement into a roost was spread over a period of time between sunset and dark, as the eagles usually flew 1 or 2 at a time a few minutes apart. Once during a snow storm, several eagles never left the cottonwood staging area for their usual roost in more protected ponderosa. Also, in the Piedra-San Juan area, ravens consistently left for their roost area about 1/2 hour before eagles. The two species were often seen around carrion and in perches together, and a raven roost was located near the Bartlett site. Ravens were also noted flying up Negro Canyon prior to eagle flights.

In both the Negro and Bartlett roost areas, very definitive patterns of flight were evident (Figures 9, 32). For the most part, eagles heading to roost flew along the terrain rather than around it. They did top a low ridge to the west of the Bartlett site; but at Negro they would fly the lake to the canyon, then follow the drainage until it forked into the roost stand. Particularly the Negro Canyon eagles were seen flying into the roost in almost total darkness, somewhat later than typically seen in most other studies. Thus, many roost associated flights may be lost to daylight observations. In the roosts, some perch changing and low vocalizations as described by Edwards (1969) and Lish (1975) occurred as the eagles arrived, prior to settling in for the night.

Specific Site Descriptions

In the following narratives on known or potential roosts, each site has been numbered to correspond with Figure 6B and the topographic maps provided for each description. The name of the quadrangle from which each map is taken is printed beneath the legend.

Piedra Staging Area (1)

This area of mature cottonwoods (Figures 7-9) was a consistent staging, or congregating, area for up to about 15 eagles prior to evening flights into the Bartlett roost. Perching and foraging observations were also common throughout the daylight hours, presumably because of the excellent perches in the leafless trees, their proximity to the Piedra River, and the abundant big game carcasses in the area. Normally activity, i.e., numbers of eagles, vocalizations, perch to perch movements, increased an hour or two before dark with all eagles leaving 1 or 2 at a time by total darkness. However, there is some evidence the staging area itself was used for roosting.

On 25 January, 2 adults and 1 immature were observed typically calling and relocating prior to sunset. As both darkness and a heavy snow fell, all 3 remained on their perches. At first light the following morning in continuing snow, all 3 were again observed in the same positions as the night before. On at least two other occasions, an immature was either flushed from peripheral trees in the area or seen with the head down under a wing in typical roosting fashion shortly after first light.

The staging area cottonwoods represent the southern end of a broken, essentially continuous stand lining the Piedra River, which during the winter of 1979 flowed into Navajo Lake about 1-1/2 - 2 miles downstream. The valley to the north is cultivated or managed ranch land and to the south, a widening, moderately vegetated, dry lake bottom with a few isolated cottonwoods along the periphery. Several of these were frequently used perches (Figures 9, 44). The ridges on either side of the Piedra valley are predominantly pinyon-juniper. The staging area trees, all apparently living, are estimated 60-70 feet high and 20-40 inches DBH. Interestingly, despite the use observed, only 20.9 grams of casting material (deer and elk fur) was found below these trees. No favorite perches, or perch trees were evident. Eagles used both higher, peripheral branches as well as lower, interior ones. (Both cases were noted on the apparent overnight roost during the 25 January snowstorm.) Located in an open valley, this area is not well sheltered from severe weather conditions.

Bartlett Roost (2)

The Bartlett roost (Figures 10-14), named after a small store, lies along the north side of the San Juan valley, near its confluence with the Piedra. The roost area is approximately one mile north of the lake in the bottom of a small, narrow drainage. It was located by documenting the consistent evening flight pattern from the staging area, and then visually following the eagles into the roost from subsequent vantage points. Other evening flight observations in the lower Piedra and upper San Juan valleys indicated that most eagles in the vicinity apparently used the Bartlett area for roosting. However, once this roost was

identified, efforts were redirected to locating other high-use areas around the lake; so total counts of eagles using the roost are not available. On 7 February, 3 adults and 2 immatures came in just before dark, following an influx of 250-300 ravens also going to roost nearby. On two other occasions, when the nightime temperature had dropped below 0° F, an eagle was found in the roost area near midday.

The Bartlett roost is composed of about 10-15 mature ponderosa pine clustered linearly along an intermittent stream bed. Casting material, prey remains, whitewash, and feathers indicated 4 trees received most use: 2 adjacent live trees at the north end of the group (70 feet, 25 inches DBH) and 2 snags 200 and 300 yards downstream (60 feet, 23 inches DBH; 90 feet, 28 inches DBH, respectively; Figure 14). The stand averaged about 80 feet and 23 inches DBH; only 1 other snag was noted. The 94.4 g of casting material collected was evenly distributed between the 3 locations of highest use. There was also scattered sign beneath other live trees through the stand.

The 2 live roost trees showed large, well spaced branching in the upper 1/3; but neither they nor the snags were more than codominant with the rest of the stand. This area did seem well protected by ridges to the east and west, and higher terrain to the north; the only real exposure, if any, would come from the south as the drainage opens to the lake. Perhaps the live roosts are more heavily used during inclement weather, in favor of the open snags in the southern portion of the stand. Some prey remains were found beneath a mature ponderosa about 1/2 mile north of the lake in the same drainage, indicating at least a feeding perch and possibly more scattered roosting in the area. The predominant vegetation is pinyon-juniper; but scattered, mature ponderosa are not uncommon.

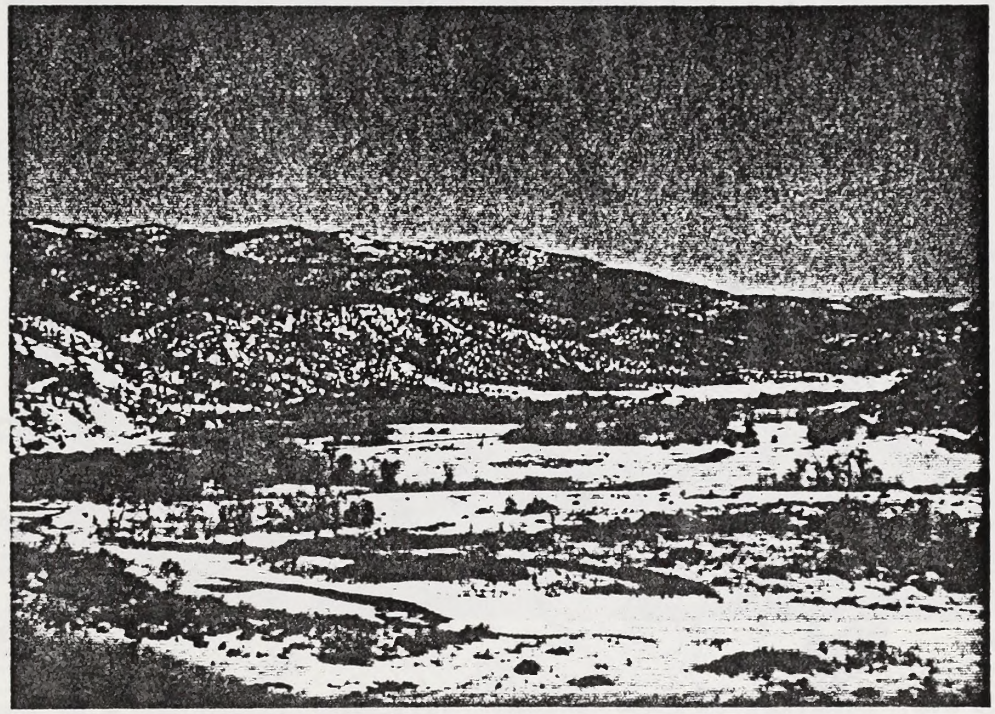
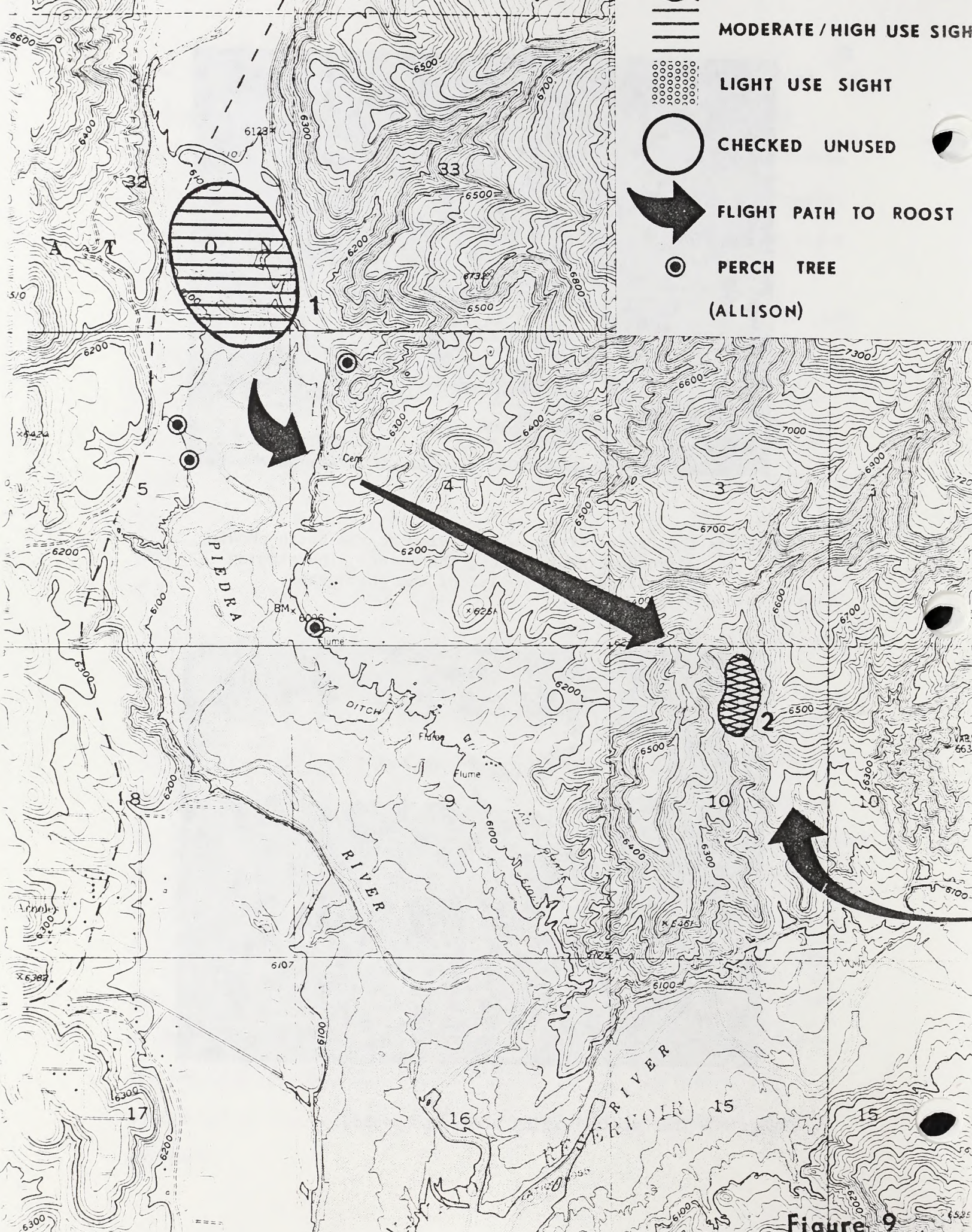


Figure 7 - The Piedra River valley; view to the north showing cottonwood groves along the river. The staging area is near the center of the photograph.

Figure 8 - The Piedra staging area cottonwoods.


MODERATE / HIGH USE SIGH
LIGHT USE SIGHT
CHECKED UNUSED
FLIGHT PATH TO ROOST
PERCH TREE
(ALLISON)
PIEDRA
RIVER
RESERVOIR
DITCH
Flume
Cem
BM
32
33
1
2
3
4
5
8
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15
16
17

Figure 9

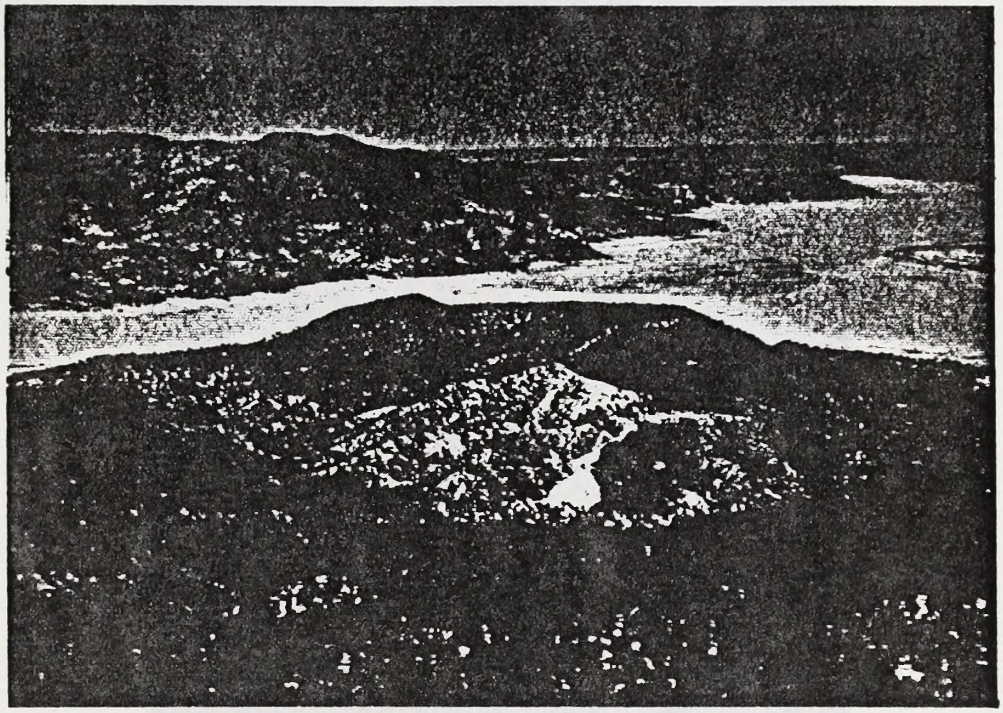


Figure 10 - Bartlett roost area, located in the drainage left of the sunlit, snow covered ridge. View is south showing Piedra (right) and San Juan (left) confluence.

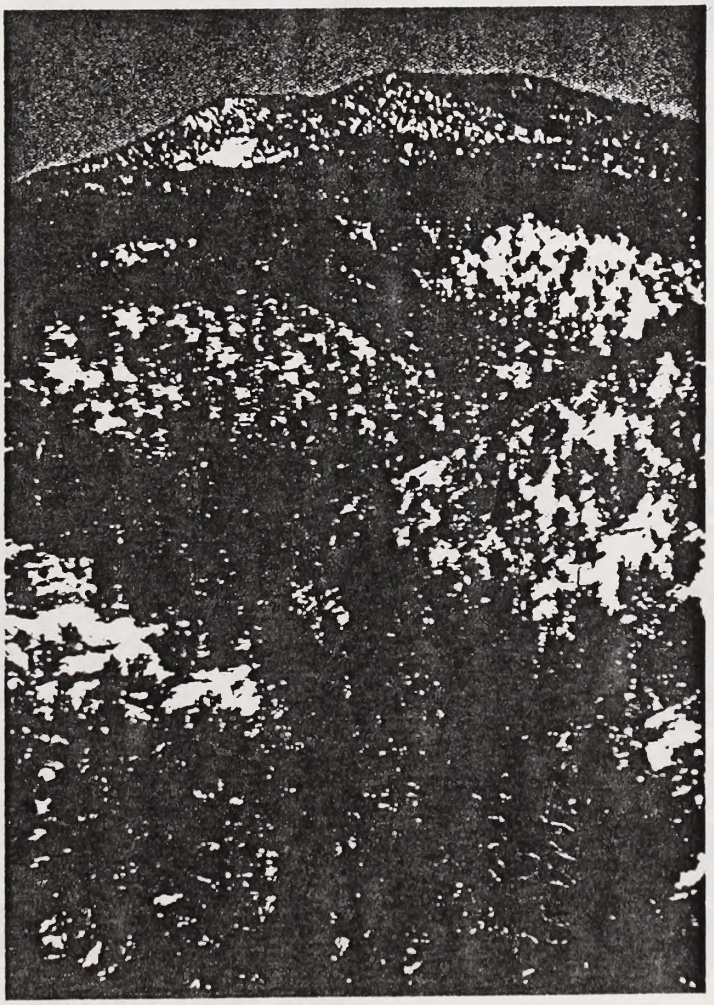


Figure 11 - Bartlett roost area in a view up the drainage.

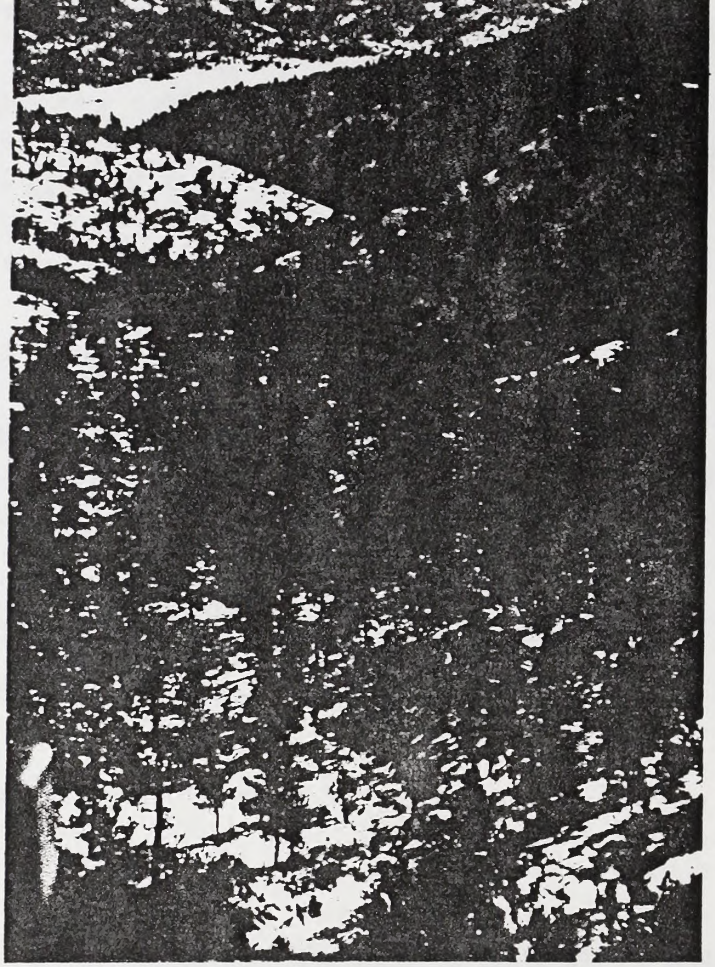


Figure 12 - Bartlett roost in a view down the drainage with the San Juan valley in the background.

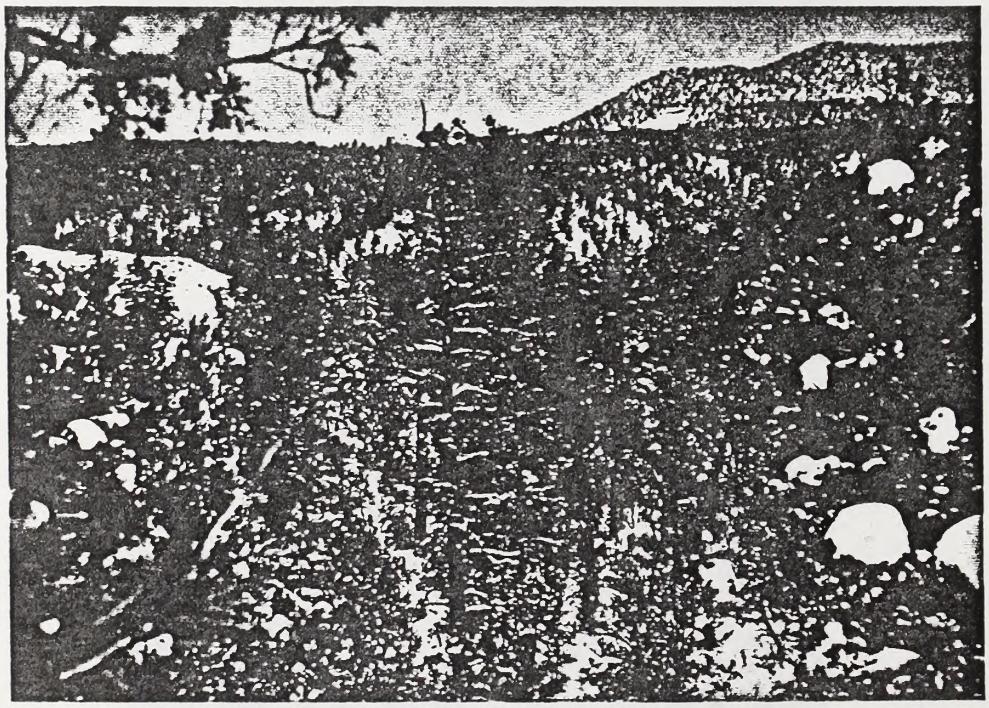


Figure 13 - A ground view looking north through the Bartlett roost area.

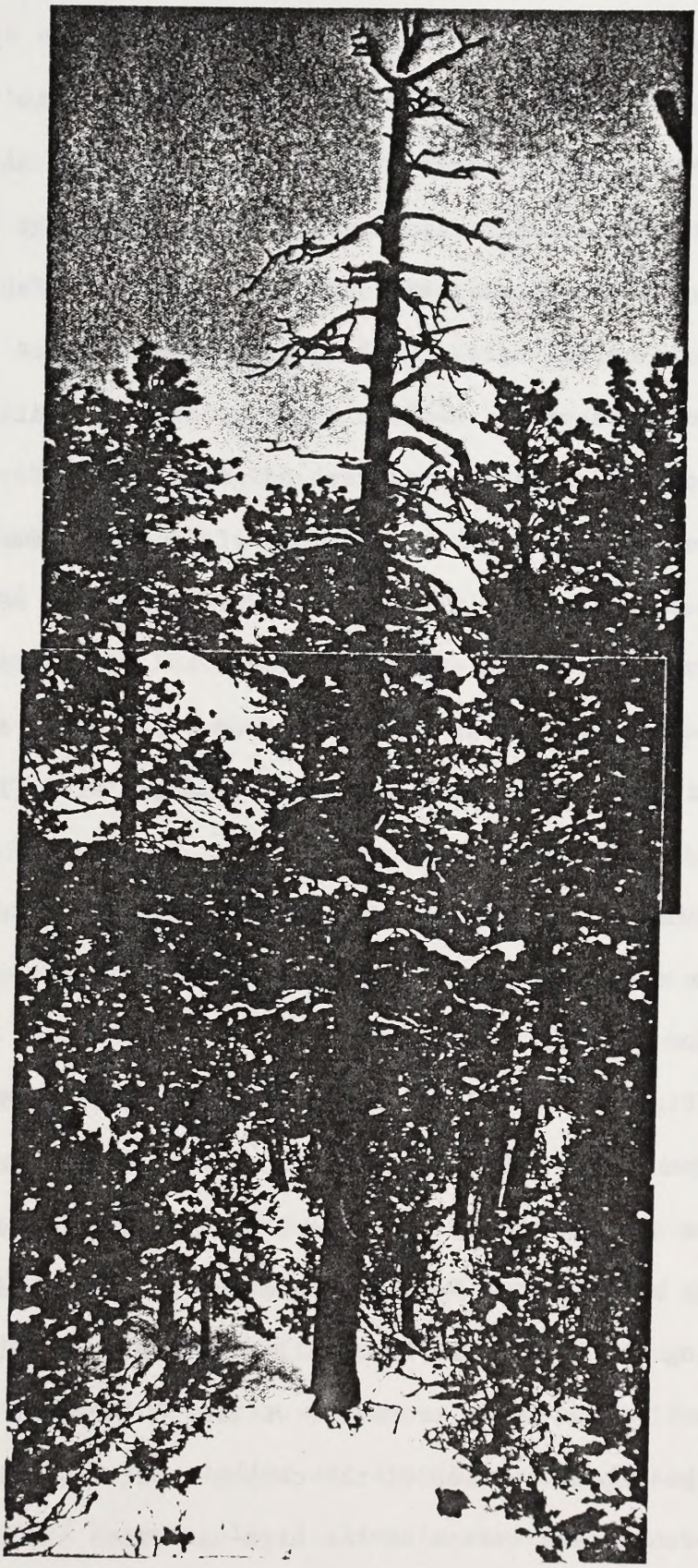


Figure 14 - One of the two ponderosa snag roost trees in the Bartlett roost area.

Bancos Roost (3, 4)

Bancos Canyon enters the San Juan Arm of Navajo Lake from the east. Several bald eagles were nearly always observed in the canyon or near its mouth along the lake's eastern shore. Most sightings in Bancos occurred along the northern shore or ridgeline. On 20 February, during a late afternoon aerial survey, 9 immatures were recorded perched in an old growth ponderosa pine. A roost was suspected and later confirmed by the combination aerial habitat survey and ground check for evidence. Two sites were located on the north shore of Bancos in small, north-south running side canyons (Figure 15). Unfortunately, access to the sites themselves during the eagles' presence was prohibited by ice on the lake. Because the amount of casting material, prey remains, and whitewash indicated far greater use of the eastern site (1122.1 g vs. 123.8 g), only site 4 is considered a roost. However, from their proximity to the shoreline and the diurnal activities of eagles in the area, both sites may also serve as daytime perches. The prey remains found support this contention.

Site 3 (Figure 16) is located in the first small drainage entering Bancos from the north. The stand consists of 15-20 ponderosa pine growing in the stream bed and up the east hillside (west exposure). Only 2-3 snags were noted. Most evidence was concentrated under 3 live trees measuring 65, 80, and 85 feet tall with DBH's of 23.5, 20, and 28 inches, respectively. These trees are within 50 yards of each other and situated in the higher portion of the canyon about 1/4 mile from the lake. The more exposed nature of the high-use trees and shallowness of the drainage point to a possible secondary or fair weather use of this area.

Site 4 is a larger ponderosa stand (> 25 large trees) in the second northside Bancos tributary canyon. The character of this somewhat denser stand is essentially the same as the first site, with trees in the streambed extending up the east slope. There are 5-6 large snags present, 1 of which (85 feet, 28 inch DBH) was apparently a primary roost tree. It was located upslope from the stream such that the upper portion of the tree was above the ridgeline (Figure 17). About 100 feet to the south, essentially in the drainage, was the heaviest used roost with nearly three times the amount of casting material of the other two roosts combined (Figure 18). This tree (80 feet, 23 inches DBH) was live with a dead upper 1/3, and besides being in the streambed, was well protected by 4 other large pine within about 60 feet. The third heavily used roost identified, a live tree, was 150 feet down the draw and also in the bottom (Figure 19). It was the largest tree recorded in the area at 120 feet and 37 inches DBH, yet this tree was essentially codominant with other large ponderosa. The limited evidence at this tree and the upstream roost suggest the center tree might be a preferred, or primary site within the stand.

A third area of apparent suitable nature in the next drainage east of the roost was checked for eagle activity, but no sign was found. Seven large, live ponderosa pine and 3 snags were located in the small, northeast-southwest running side canyon. From the air and even on the ground the site appeared equally as good as those used. One possible influencing factor is the earlier and lengthier ice blockage of the more interior portion of Bancos. Local climatic varitions and habitual use elsewhere may also be considerations.

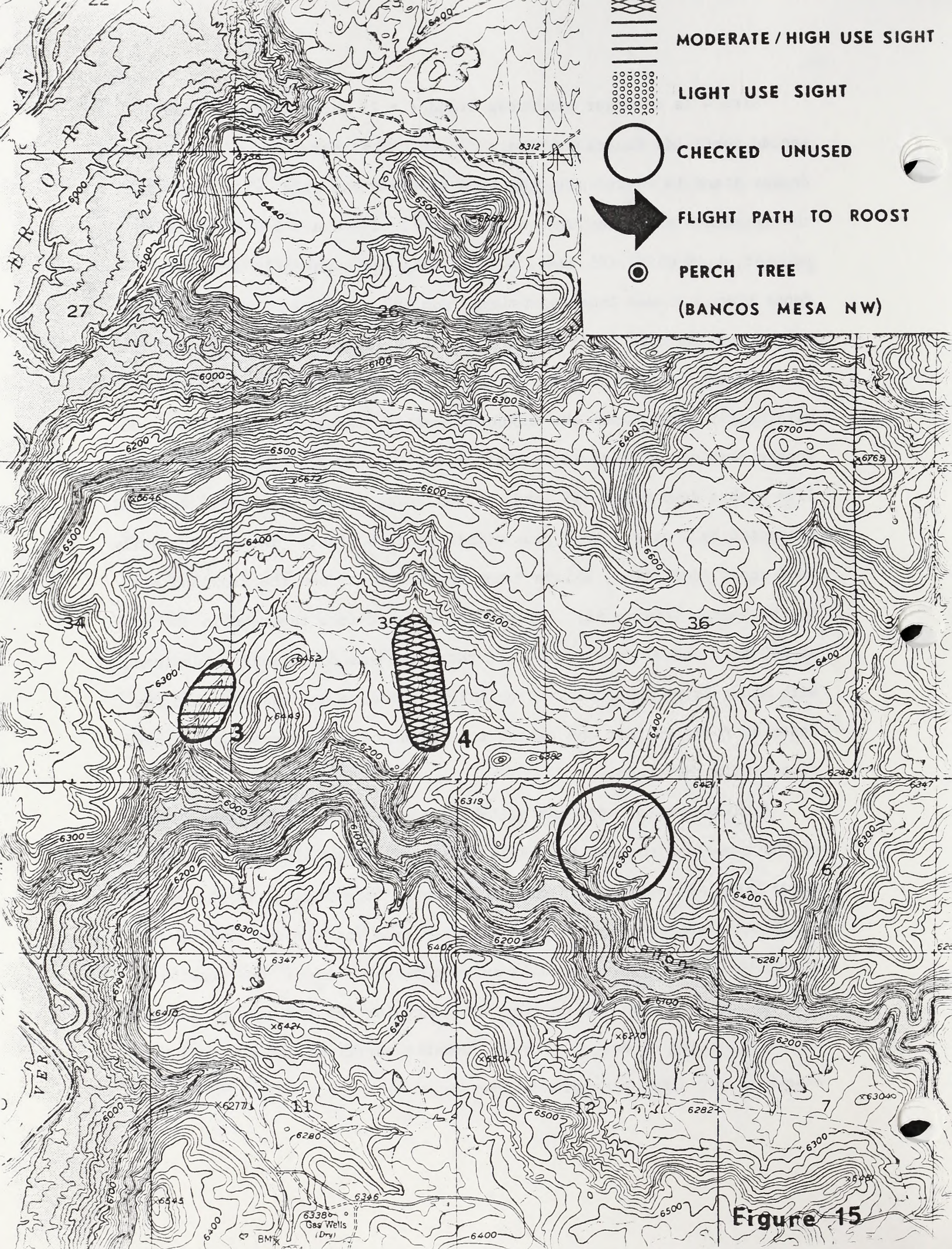

MODERATE / HIGH USE SIGHT
LIGHT USE SIGHT
CHECKED UNUSED
FLIGHT PATH TO ROOST
PERCH TREE
(BANCOS MESA NW)
Canon
Gas Wells
(Dry)

Figure 15

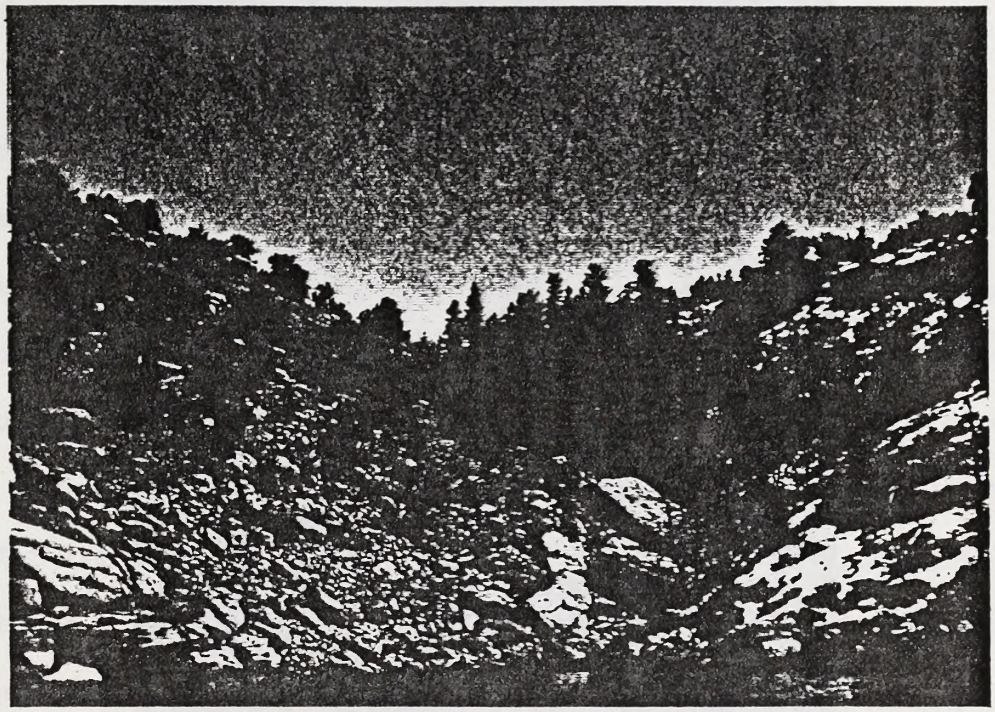


Figure 16 - Bancos perching and possible roosting Site 3.

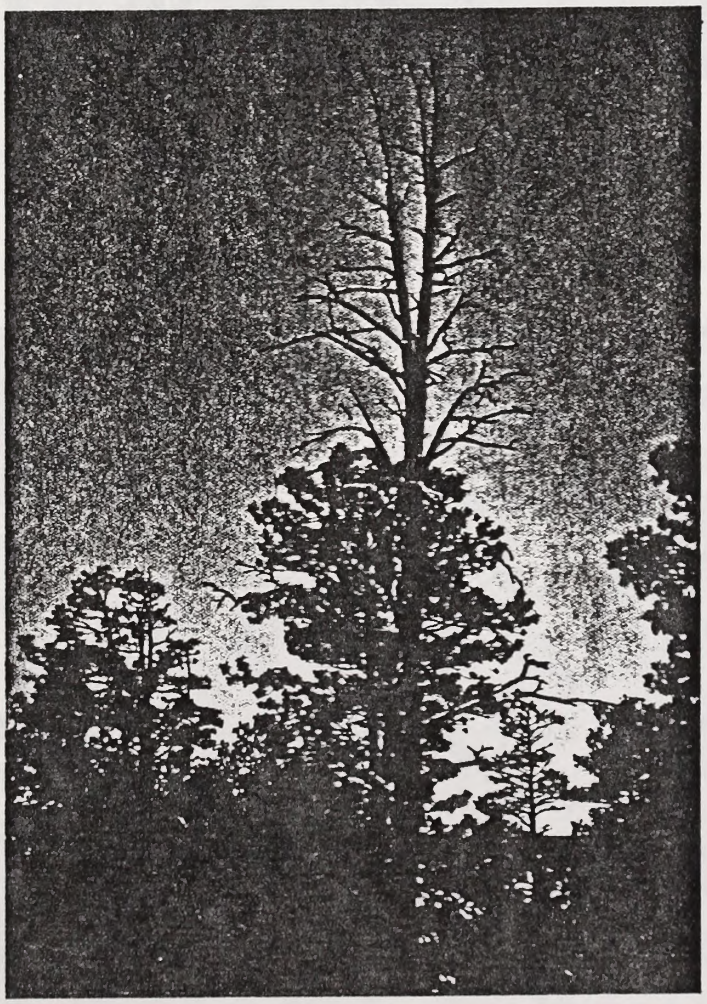


Figure 17 - Heavily used snag within Bancos roost area.

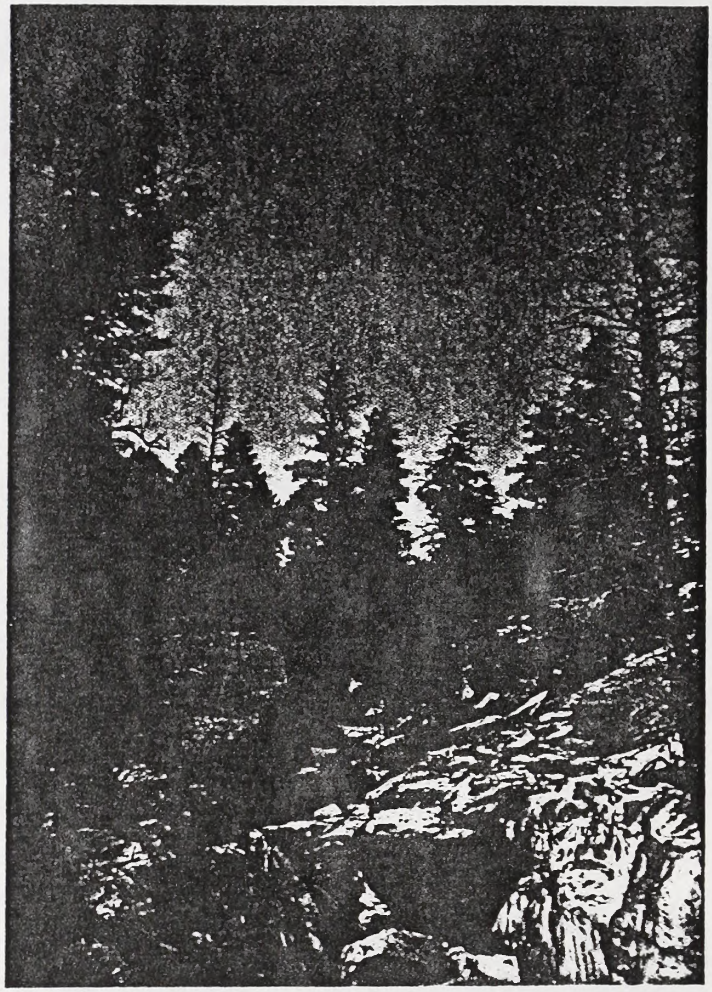


Figure 18 - Ponderosa showing heaviest use in the Bancos roost area.

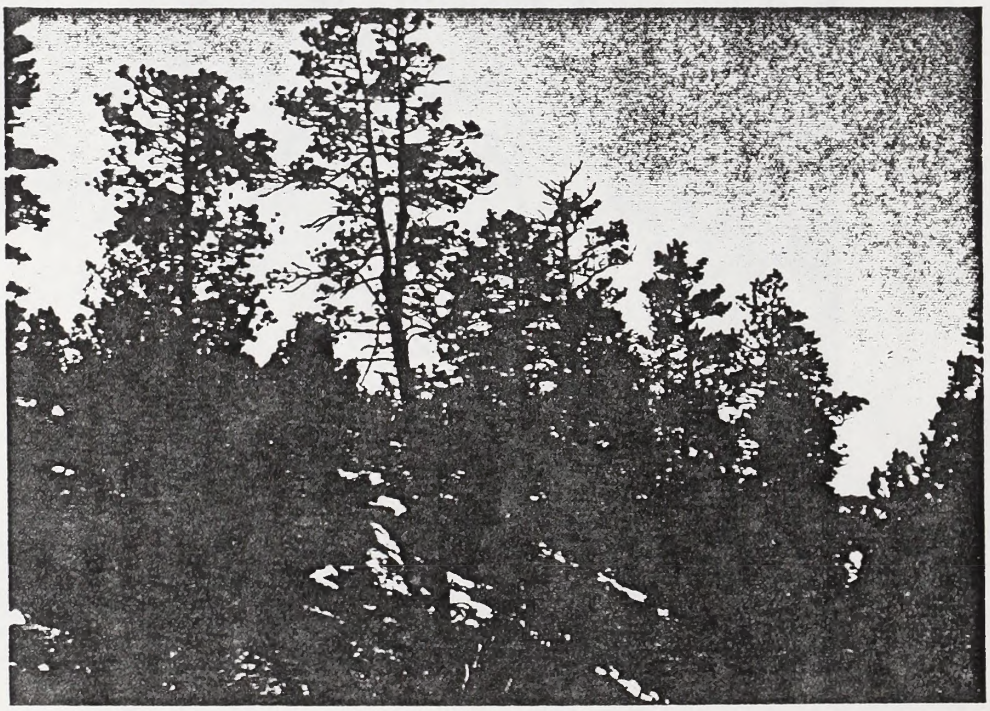


Figure 19 - Heavily used tree in the Bancos roost area.

Nest Tree (5)

The nest tree (Figures 20, 21) is a large ponderosa snag (95 feet, 26 inches DBH) situated at the water's edge in a small cove on the west shore of the San Juan Arm about a mile below Bancos Canyon. The nest is old and appears too small to be an eagle's nest; if used at all, a red-tailed hawk (Buteo jamiacensis) would seem a more likely owner. However, wintering eagles were occasionally seen at the snag, as on 5 April, when 1 adult and 4 immatures were perched there at 1530. A large amount of whitewash and several castings were found beneath the tree, but no use was evidenced or observed at the 4 other nearby, live ponderosa pines. Except for the steep hillside behind, the nest tree is not offered much protection by the small cove and would seem a marginal roost site at best.

Cottonwood (6, 7)

Site 6 at the head of Cottonwood Canyon (Figures 20, 22, 23) was noted as a potential roost area from the air; however, no evidence of such activity was found on the ground. The site is included because eagles were observed at least perching several times in the ponderosa occurring there. Eight medium sized trees (40-65 feet, 24 inches DBH) are in the area, half are snags. Most of the trees are along the ridgeline which might account for the observed perching activity and paucity of roosting evidence.

Two other sites were checked downlake from Cottonwood. The first (7) was a small, southeast to northwest running canyon on the east side of the San Juan Arm, directly south of the mouth of Cottonwood. It supported about 30 moderate sized Douglas fir in both the streambed and on the north facing slope. Sizes averaged 50-60 feet high and 10-12

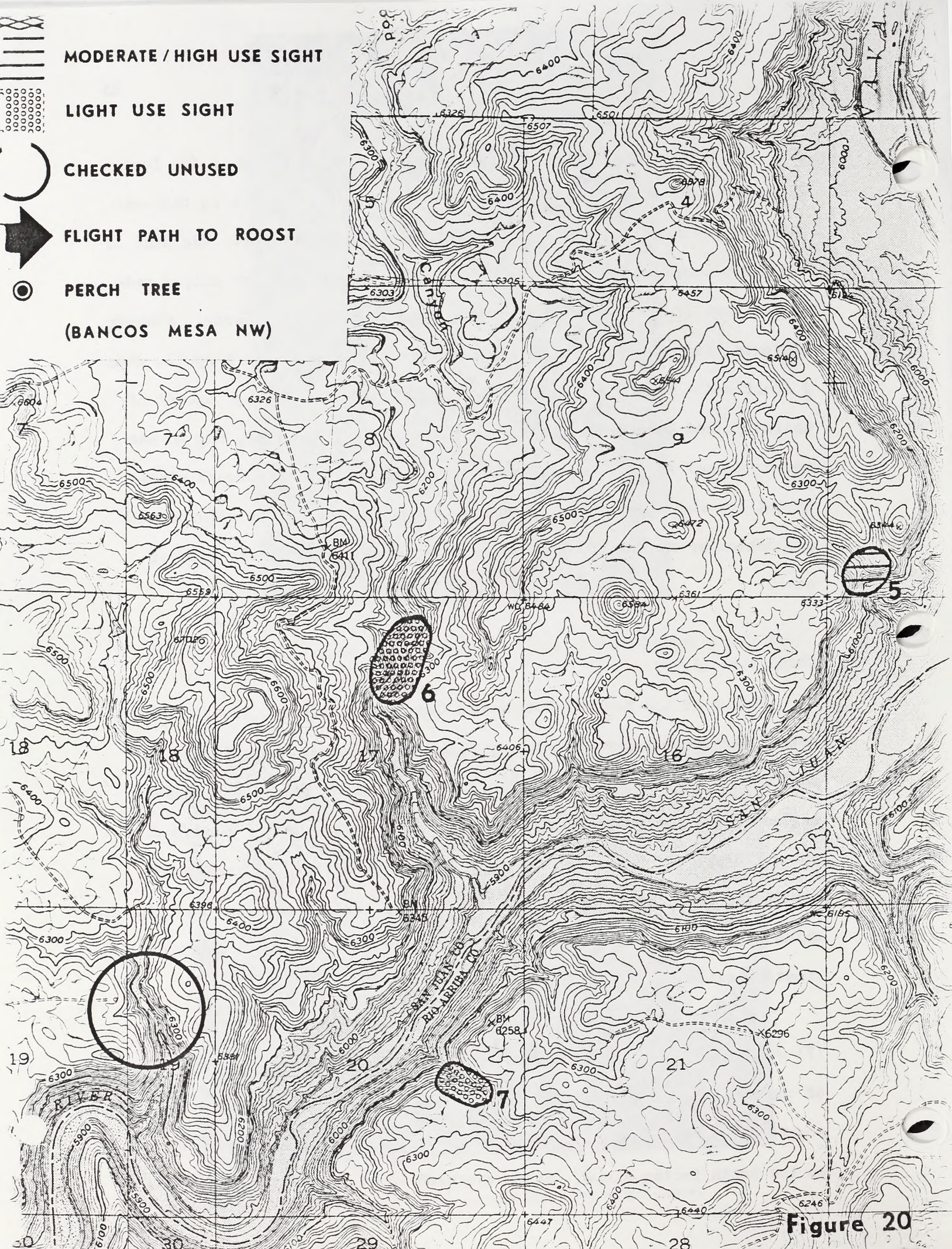

MODERATE / HIGH USE SIGHT
LIGHT USE SIGHT
CHECKED UNUSED
FLIGHT PATH TO ROOST
PERCH TREE
(BANCOS MESA NW)
4
5
6
7
SAN JUAN CO.
RIO ARRIBA CO.
SAN JUAN
RIVER

Figure 20

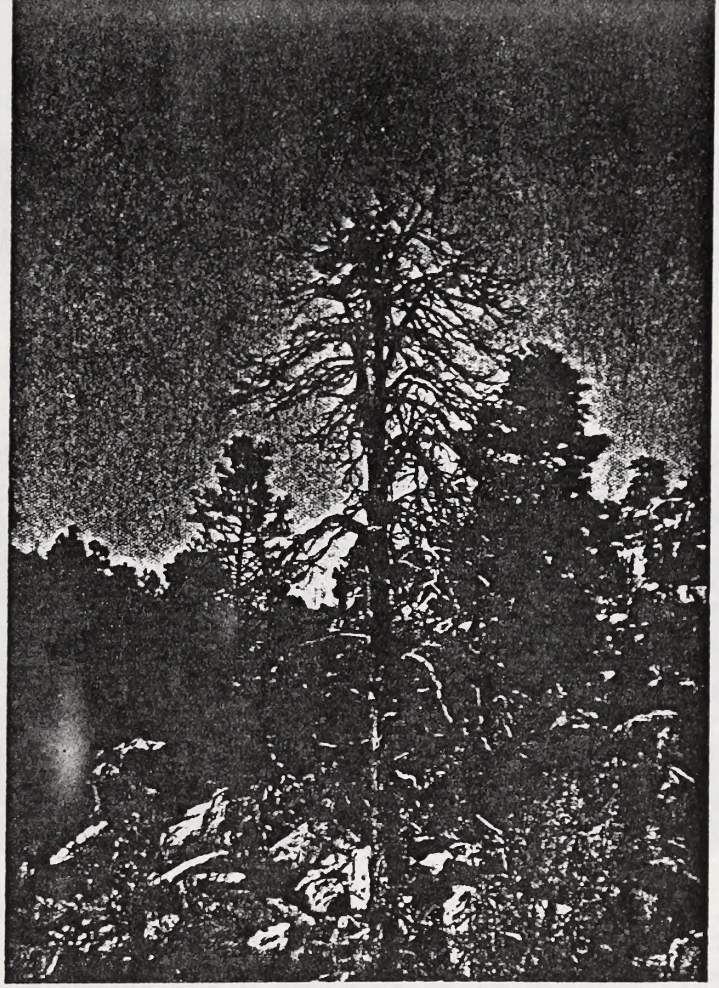


Figure 21 - The nest tree along the west shore of the San Juan arm.

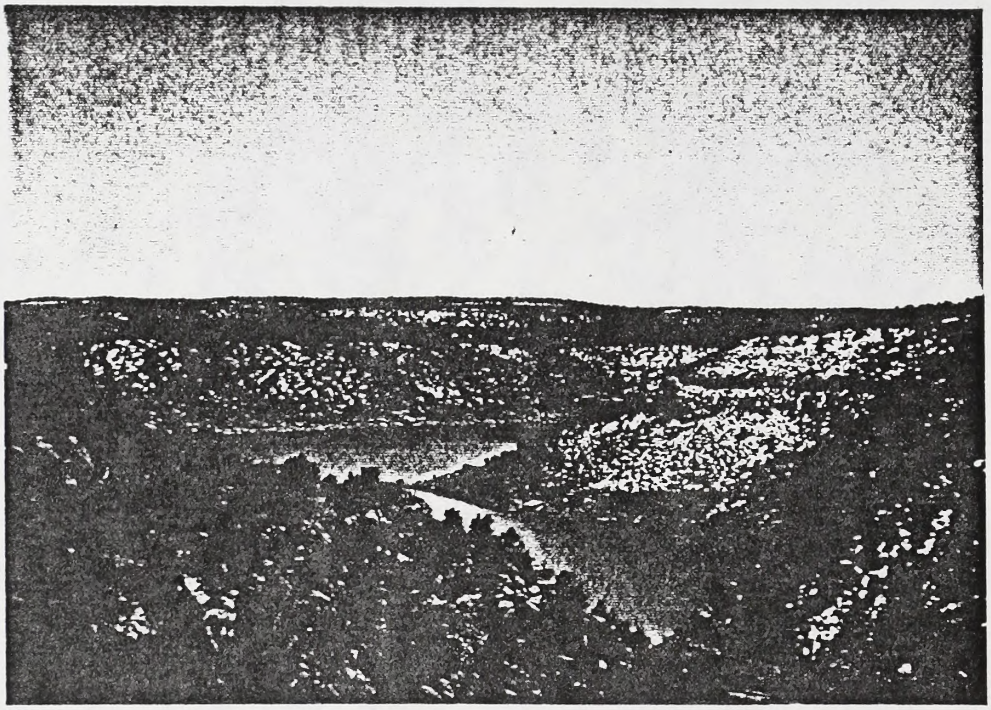


Figure 22 - Cottonwood Canyon in a southeasterly view toward the San Juan arm.

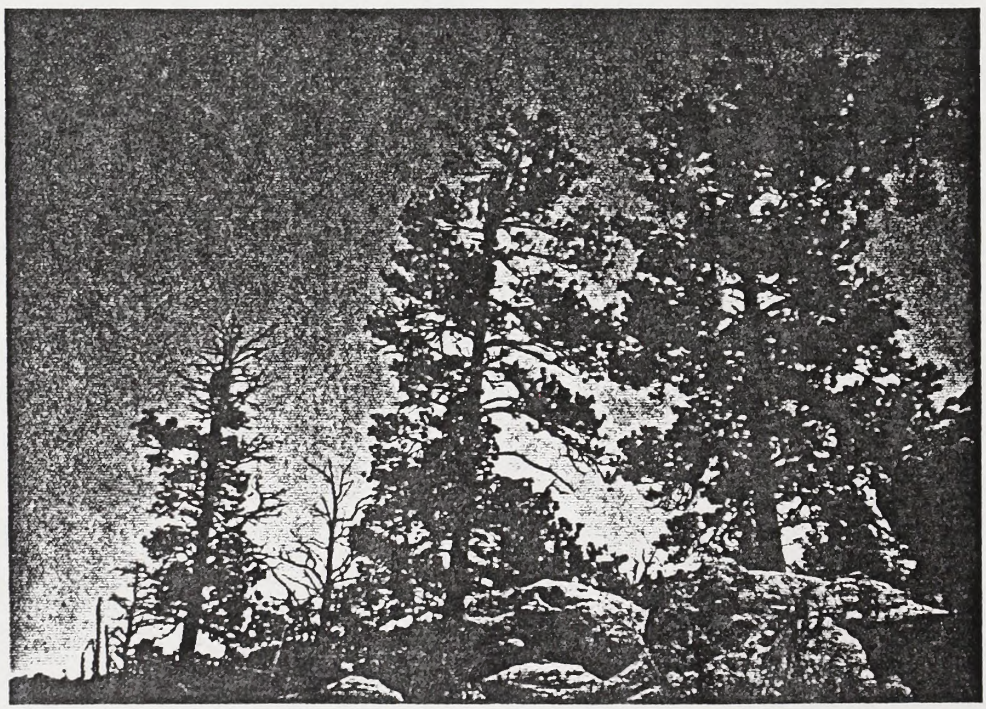


Figure 23 - The ponderosa perch trees of Cottonwood Canyon.

inches DBH, with the largest (4-5 trees) noted at 100 feet and 19 inches. No snags were observed. Of the casting material found most was thought to be owl; eagle use was apparently light.

The second unused site was at the head of a larger, north-south running canyon, entering the San Juan Arm on the north side of the S-bends. A stand of about 30 Douglas fir was clustered in the drainage and on the west slope. The average size was 80-90 feet in height with a 20-22 inches DBH; only a few snags were noted. No sign was found.

La Jara (8, 9)

The first potential roost site in La Jara Canyon was located about 1-1/2 miles from the main lake on the south shore (8). A small, north-south running canyon had a stand of 15-20 Douglas fir (60-70 feet, 20-22 inches DBH) growing in the stream bed and up the adjacent slope. Some castings and whitewash were found beneath a large, living ponderosa pine (100 feet, 28 inches DBH) located in the drainage about 75 yards from the water (Figure 25). A deer scat was found below the only other ponderosa pine, a snag 175 yards upstream and on a northeast facing slope. This area was apparently not used heavily, but a preference for the larger, open branching of ponderosa over the denser foliage and branching of Douglas fir is indicated.

A little whitewash was noted at Site 9 to the east, but otherwise there was no evidence to indicate much eagle use. This site consisted of 8 large ponderosa pine (90-100 feet) loosely situated among a Douglas fir stand in another small drainage running southwest to northeast. Two broken topped snags were present in this area less than 1/4 mile from the water. Further to the east near the head of La Jara another group of 8 scattered ponderosa snags occurred in a canyon entering from the

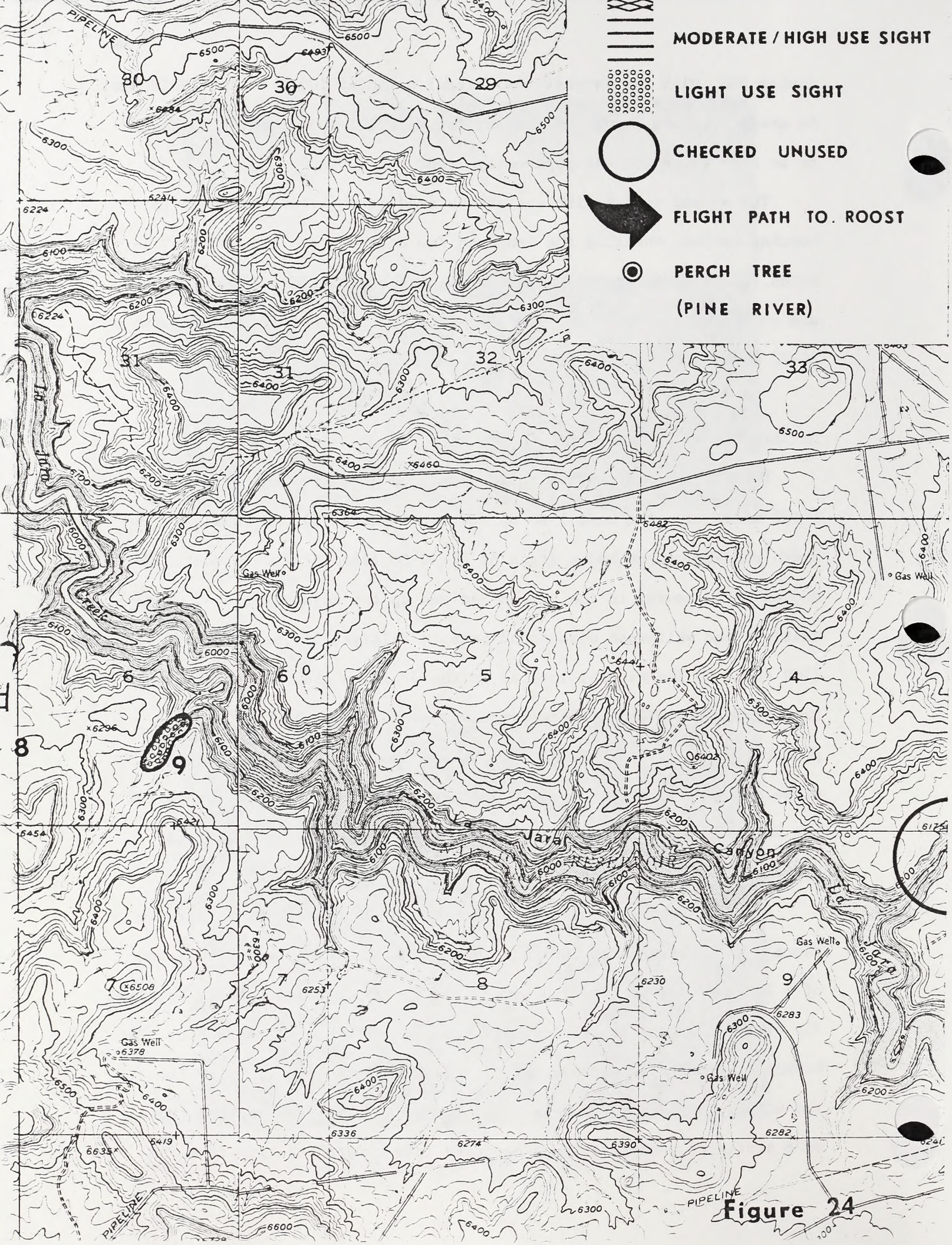

MODERATE / HIGH USE SIGHT
LIGHT USE SIGHT
CHECKED UNUSED
FLIGHT PATH TO. ROOST
PERCH TREE
(PINE RIVER)
PIPELINE
La Jara Creek
La Jara Canyon
Gas Well
30
29
31
32
33
6
5
4
8
9
7

Figure 24

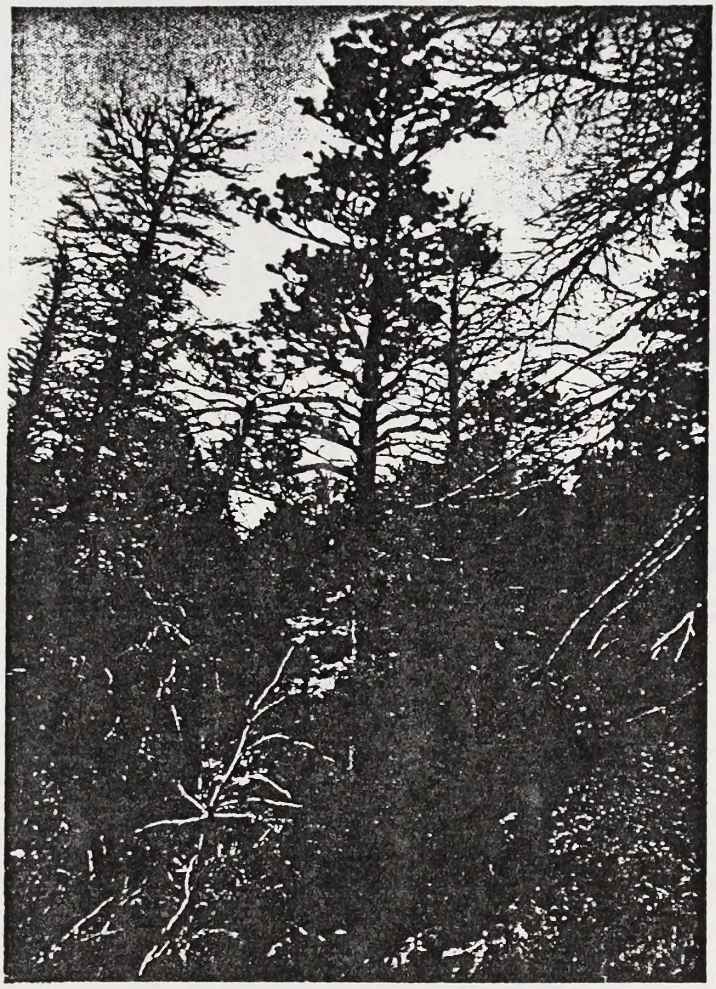


Figure 25 - The ponderosa use tree located in La Jara Site 8.

Figure 26 - Ponderosa snag used in Dick Earl Canyon Site 10.

north. Some whitewash was seen but no definitive signs of eagle activity were found. As mentioned under the Bancos discussion, the extremities of the side canyons are frozen first and longest. Such conditions may be affecting eagle use of potential roost and/or perch sites.

Dick Earl (10, 11)

Dick Earl Canyon enters the San Juan Arm from the north about five miles above Navajo Dam. A potential roost site (10) was identified from both the air and ground in a box canyon near the upper end of the canyon (Figure 27). The box runs northeast to southeast and is timbered with 10 Douglas fir (60-70 feet), mostly on the north facing slope and rim. Only 1-2 castings were found under 1 of these live trees on the rim. Most casting material, whitewash, and prey remains were concentrated beneath a large, single ponderosa snag (93 feet, 32 inches DBH) at the water's edge (Figure 26). There was 1 Douglas fir snag upslope but it showed no use.

At the end of a small inlet opposite the mouth of Dick Earl lies another potential roost or, more likely, perch site (11). This canyon lies along an east-west axis, with about 20 Douglas fir (averaging 17 inches DBH) scattered on the north facing slope 1/4 mile from shore. Prey remains (rabbit) and a few pellets were found under the largest tree in the stand (92 feet, 35 inches DBH). There were 3-4 unused snags present. One immature bald eagle was seen in this area late in the day on 4 April.

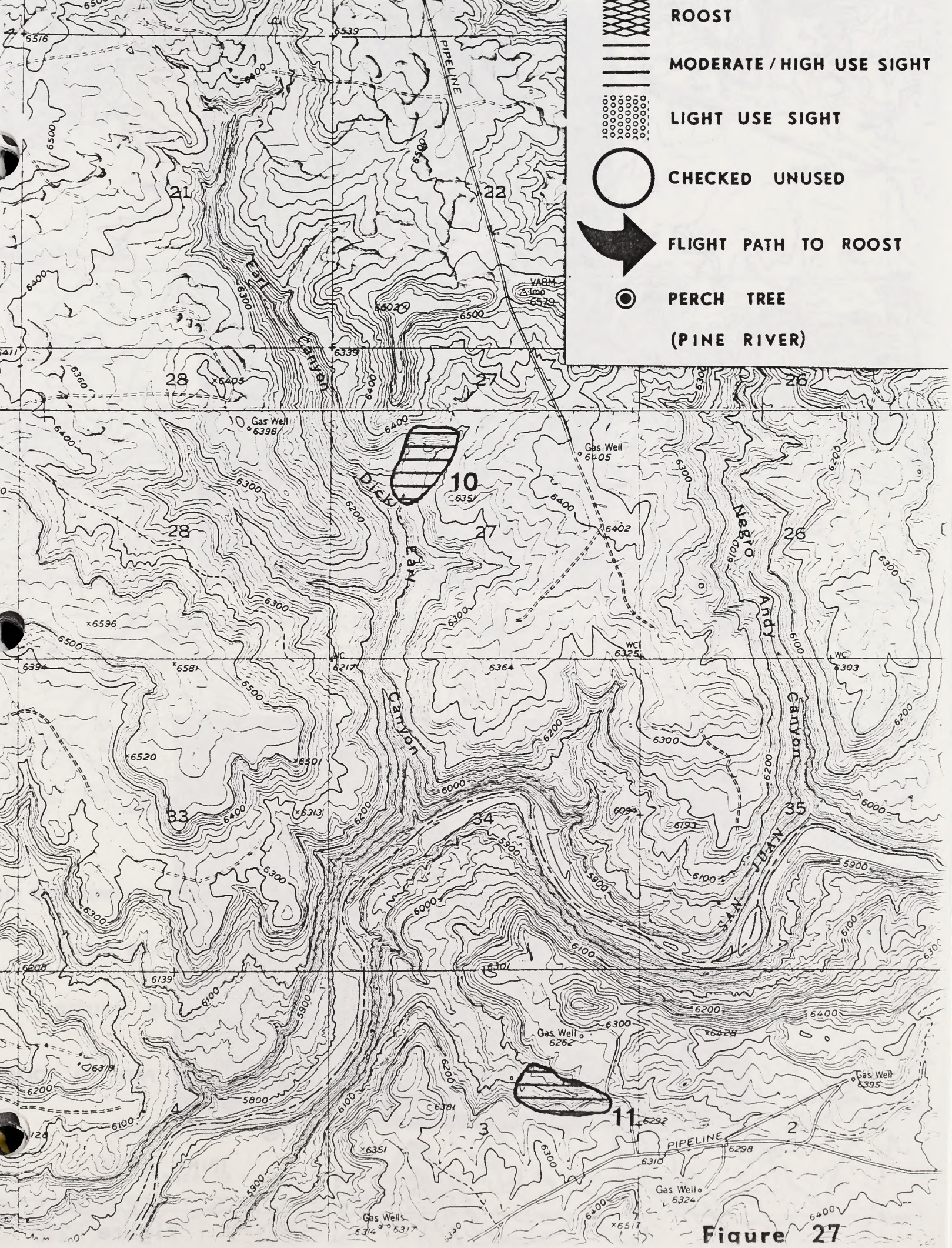

ROOST
MODERATE / HIGH USE SIGHT
LIGHT USE SIGHT
CHECKED UNUSED
FLIGHT PATH TO ROOST
PERCH TREE
(PINE RIVER)
PIPELINE
Earl Canyon
Dick Earl Canyon
Negro Andy Canyon
SAN JUAN
Gas Well 6398
Gas Well 6405
Gas Well 6262
Gas Well 6395
Gas Well 6324
Gas Wells 6314 & 6317
10
11
21
22
27
28
26
33
34
35
4
3
2

Figure 27

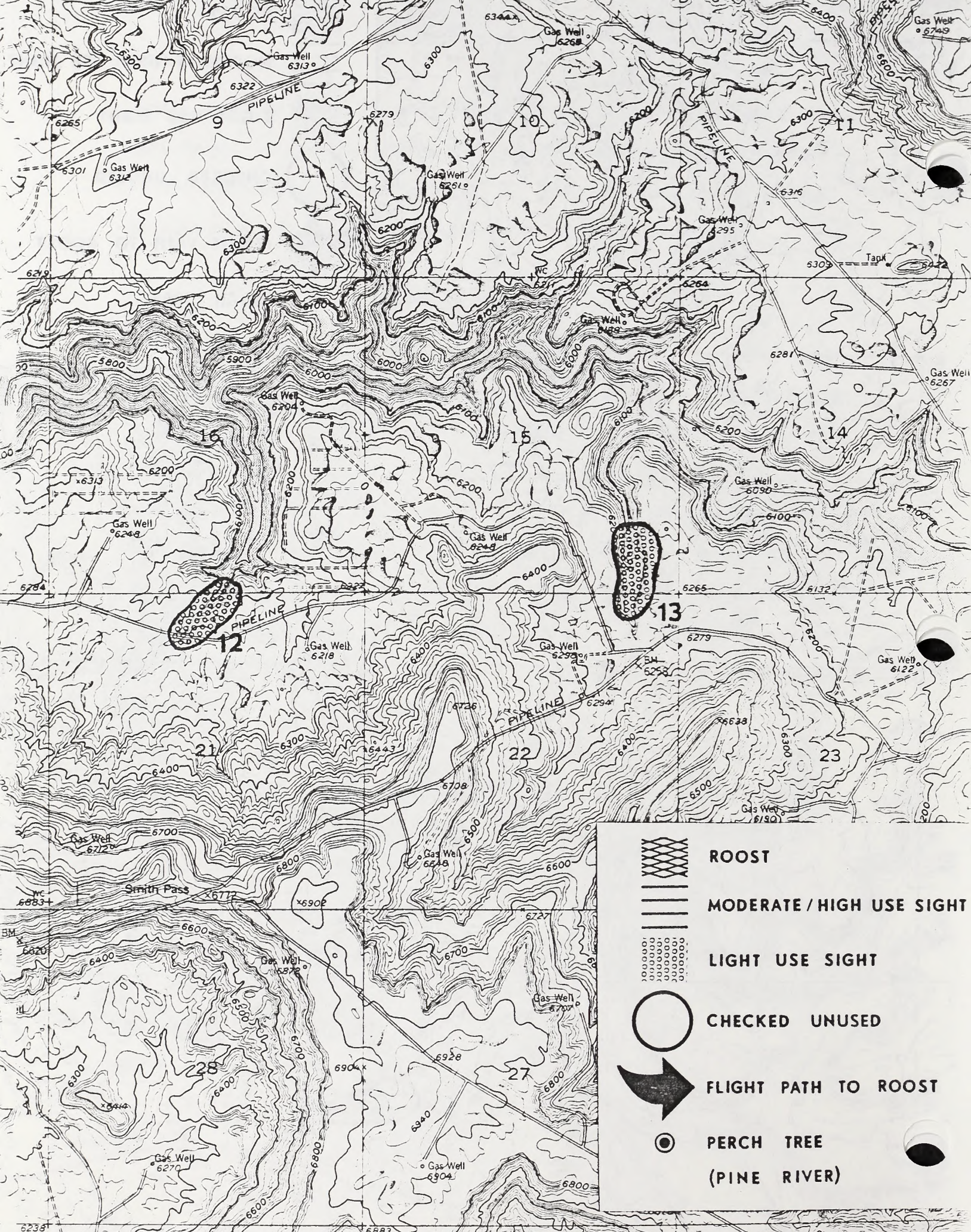

ROOST
MODERATE / HIGH USE SIGHT
LIGHT USE SIGHT
CHECKED UNUSED
FLIGHT PATH TO ROOST
PERCH TREE
(PINE RIVER)
PIPELINE
Smith Pass
Gas Well
Tank
9
10
11
12
13
14
15
16
21
22
23
27
28

Figure 28

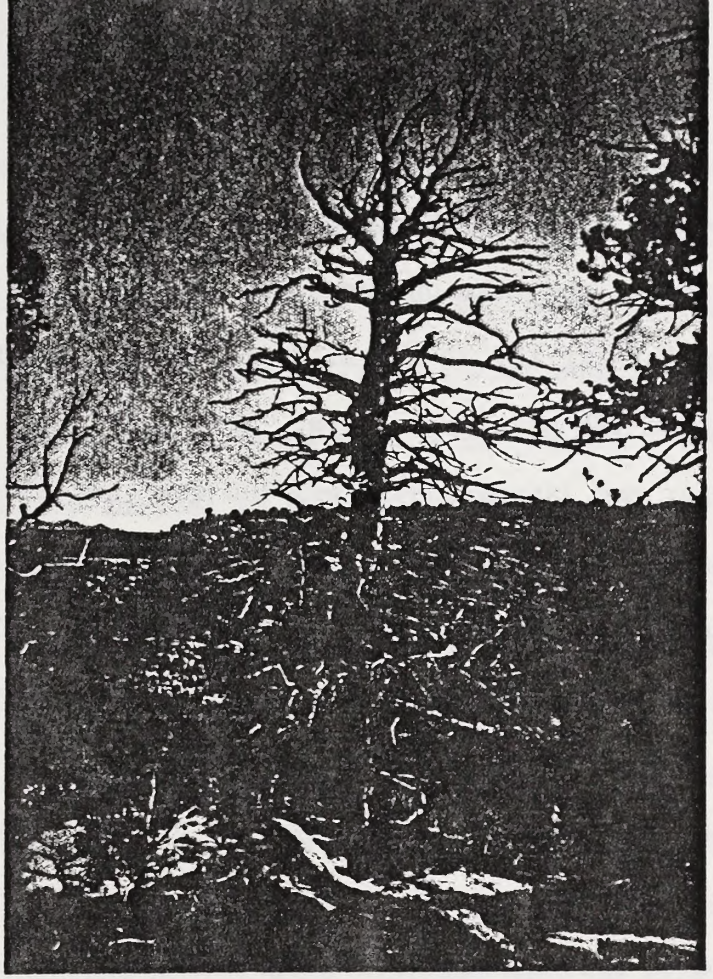


Figure 29 - Probable loafing of feeding perch in Frances Canyon.

Figure 30 - Lightly used area (Site 13) in Frances Canyon.

Frances (12,13)

The first bald eagle use site in Frances Canyon (12) was about a mile from the main body of the lake on the south side (Figure 28). A group of about 20 Douglas fir lay at the head of a short, southwest to northeast running canyon 1/4 mile from shore. Most trees were on the northwest facing slope; the largest noted was 100 feet and 35 inches DBH. Limited casting material and whitewash were found under a smaller snag (35 feet, 25 inches DBH) on the canyon rim (Figure 29). The apparent sole use of this rim snag suggests a loafing or feeding perch rather than a roost.

To the east in a second north-south canyon on the same side of Frances was a better looking stand of 15-20 Douglas fir (13). Most trees appeared mature to overmature, with their bases in the canyon and the crowns extending above (Figure 30). Some castings, whitewash, and remains of a rabbit were located beneath one tree (70 feet, 30 inches DBH) near the head of the box canyon. Overall, this stand showed potential with the large, clustered trees and a few scattered snags. Possibly the exposure of most trees above the ridge reduces the site's value as a roost, along with its interior placement in Frances Canyon.

Negro Roost (14)

The Negro Canyon area, about midway up the Pine Arm on the west side (Figure 31), is a definite roost site, located by observing eagles flying into the area at dusk. On 12 February 15 eagles headed into the canyon from both northern and southern portions of the Pine Arm (Figure 32). A subsequent aerial habitat survey showed this to be the only drainage off the Pine Arm with any sizeable group of old growth, well protected

trees. Several ground checks were required before the actual roost trees were located over a mile from the lake. On 15 February from a vantage point about a 1/2 mile from the lake, 21 eagles were seen flying individually up Negro between 1655 (about sunset) and 1820. From these sightings and evidence discovered under the high use trees, the roost was eventually located in a forked tributary canyon slightly south of the main drainage (Figure 33).

The roost area consisted of over 75 ponderosa pine (60-70 feet, 20-24 inches DBH), mostly in the drainage bottom or on adjacent side slopes. From the large amount of whitewash, castings, feathers, and prey remains below, 5 primary roost sites within the area were identified. Their distribution is shown in Figure 33. Four large, living ponderosa grouped near the juncture of the side drainage made up site A (Figure 34). Their sizes were as follows: 90 feet, 23 inches DBH; 76 feet, 22.5 inches; 76 feet, 20 inches; and 66 feet, 18.5 inches. This group of trees, showing evidence of high use, essentially had a northern exposure on a moderate slope. Site B was a lone ponderosa snag (88 feet, 23 inches DBH) situated in the drainage bottom (Figure 35). Whitewash and several castings indicated only light use.

Two live, old growth trees (90-95 feet, 28 and 23 inches DBH) comprised site C (Figure 36). They were the largest in the area and located just upslope of the drainage bottom after it forks. The exposure was northeast. Moderate amounts of whitewash, castings, and feathers were found at this location. The fourth site (D) showed heavy use comparable to the first. There were large amounts of whitewash, castings, and prey remains (including a rabbit hind quarter). Located up a

moderate slope with a northeast exposure, this lone dead, 60 foot snag (24 inches DBH) was almost at the crest of the ridge (Figure 37). Quite possibly this tree represented a feeding as well as a roosting perch. Site E was a live ponderosa (80 feet, 29.5 inches DBH) in the upper portion of the left side fork (Figure 38). The slope was again moderate and the exposure was to the northwest. Like site B, only a few castings and whitewash were evident suggesting light use.

Two other sites with signs of possible eagle use were checked on the Pine Arm. The first was a north-south running side canyon entering the east side of the Pine Arm about 8 miles north of Navajo Dam. The 20-25 Douglas fir (70 feet, 18 inches DBH) were in the bottom and on the west facing slope. The lack of apparent bald eagle use may have been due to the proximity of the Negro Canyon roost and/or the frequency of scattered Douglas fir along the east shore of the Pine Arm.

Two large cottonwoods were located in an east side, lateral canyon near the north end of the Pine Arm. The trees (40-60 feet, 24 inches DBH) were about 1/4 mile from shore. As with the side canyons of the San Juan Arm, the upper end of the Pine was frozen much of the winter. Thus the expected use of this area would be limited.

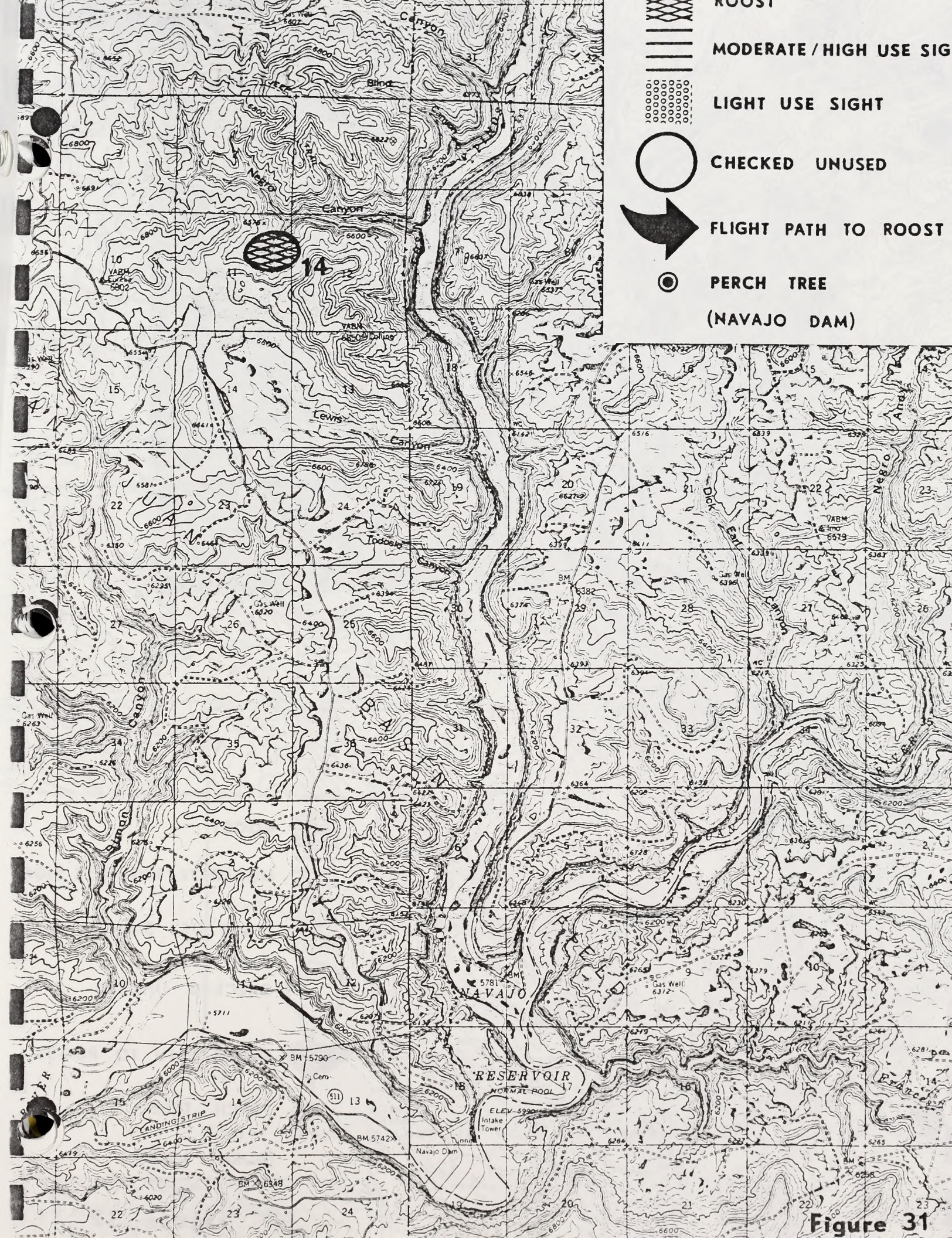

ROOST
MODERATE / HIGH USE SIG
LIGHT USE SIGHT
CHECKED UNUSED
FLIGHT PATH TO ROOST
PERCH TREE
(NAVAJO DAM)
14
Canyon
Blind
Negro
Canyon
Lewis
Canyon
Todoslo
Canyon
Dick
Earl
Canyon
Negro
Andy
Simon
Canyon
NAVAJO
RESERVOIR
NORMAL POOL
ELEV 5990
Intake
Tower
Navajo Dam
LANDING STRIP
Gas Well
Cem
BM 5790
BM 5742
BM 6348
BM 6382
BM 5781
VABM
Dolling

Figure 31

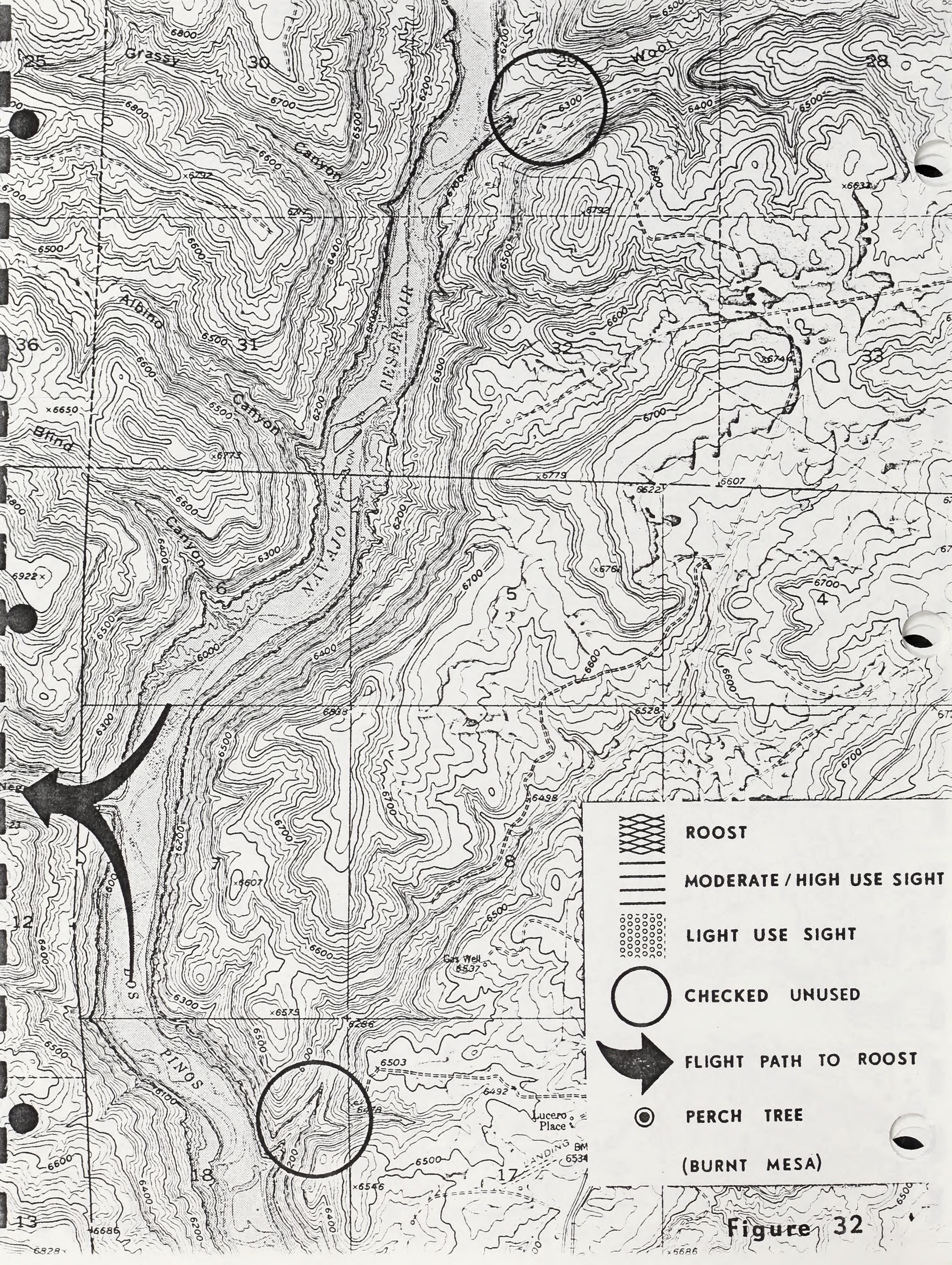
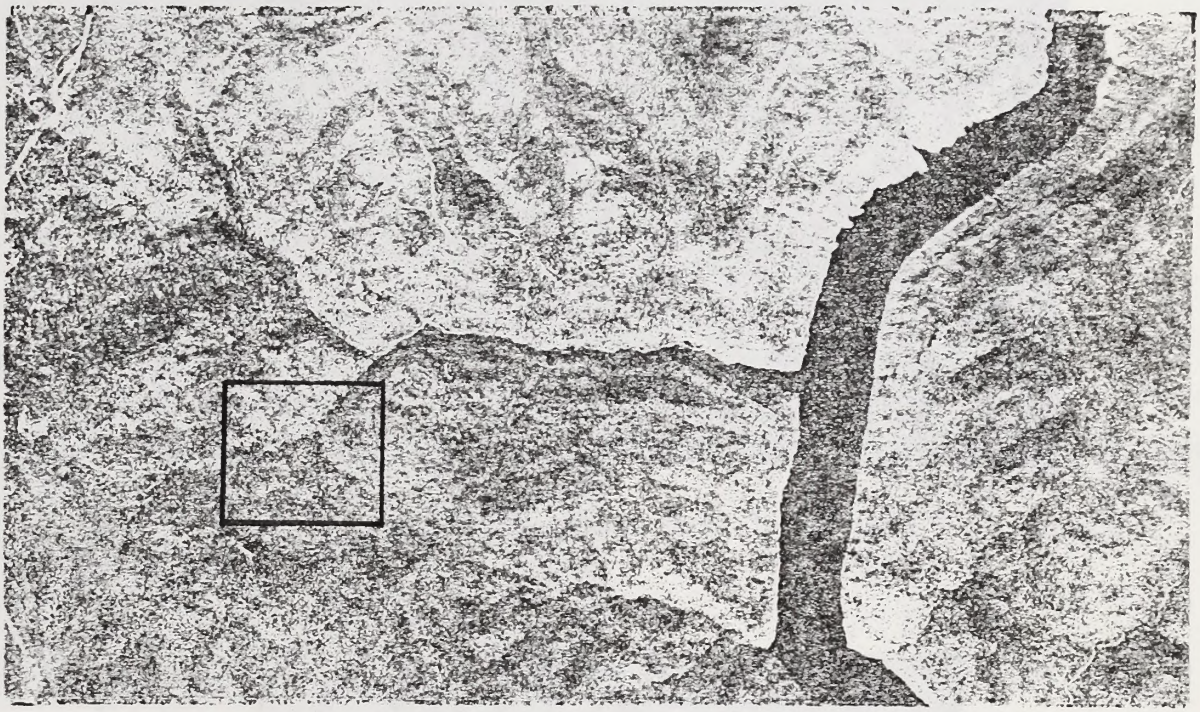
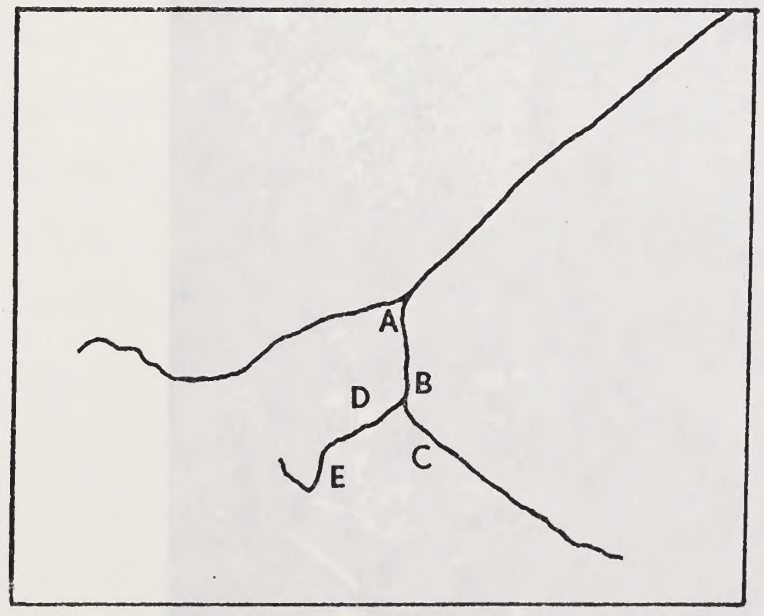

Grassy
Canyon
Wool
Albino
Canyon
Blind
Canyon
RESERVOIR
NAVAJO
PINOS
Gas Well
Lucero Place
ROOST
MODERATE / HIGH USE SIGHT
LIGHT USE SIGHT
CHECKED UNUSED
FLIGHT PATH TO ROOST
PERCH TREE
(BURNT MESA)

Figure 32



(a)



(b)

Negro Canyon (a) and its roost tree locations (b).

Figure 33

Figure 34 - A group of high use ponderosa (Site 14-A) in the Negro roost.

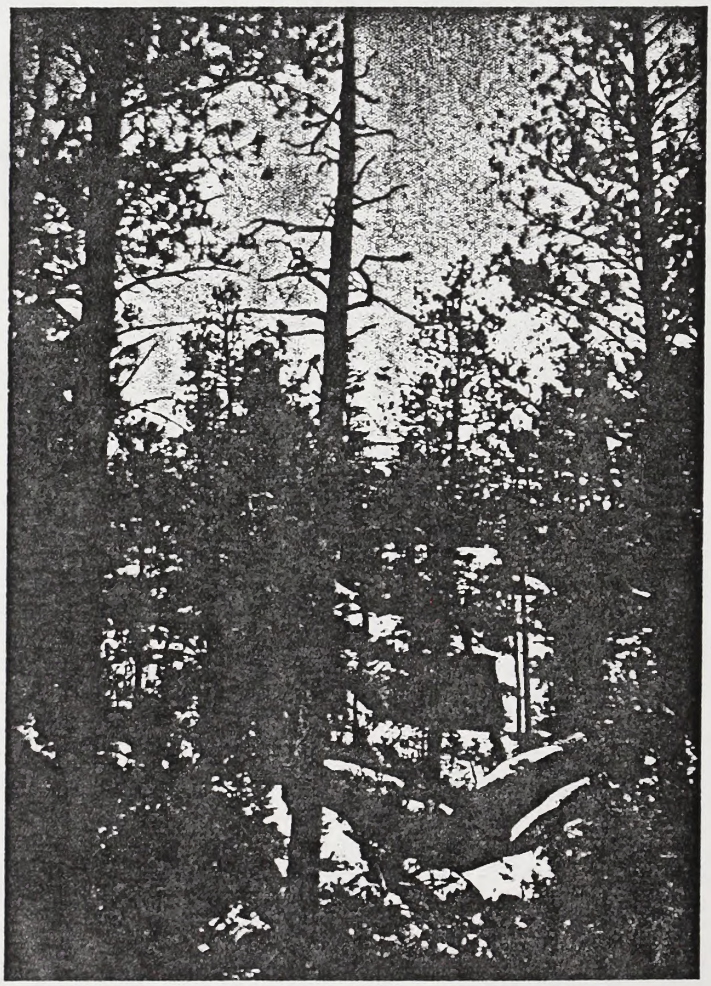


Figure 35 - A lightly used ponderosa snag (Site 14-B) in the Negro roost.

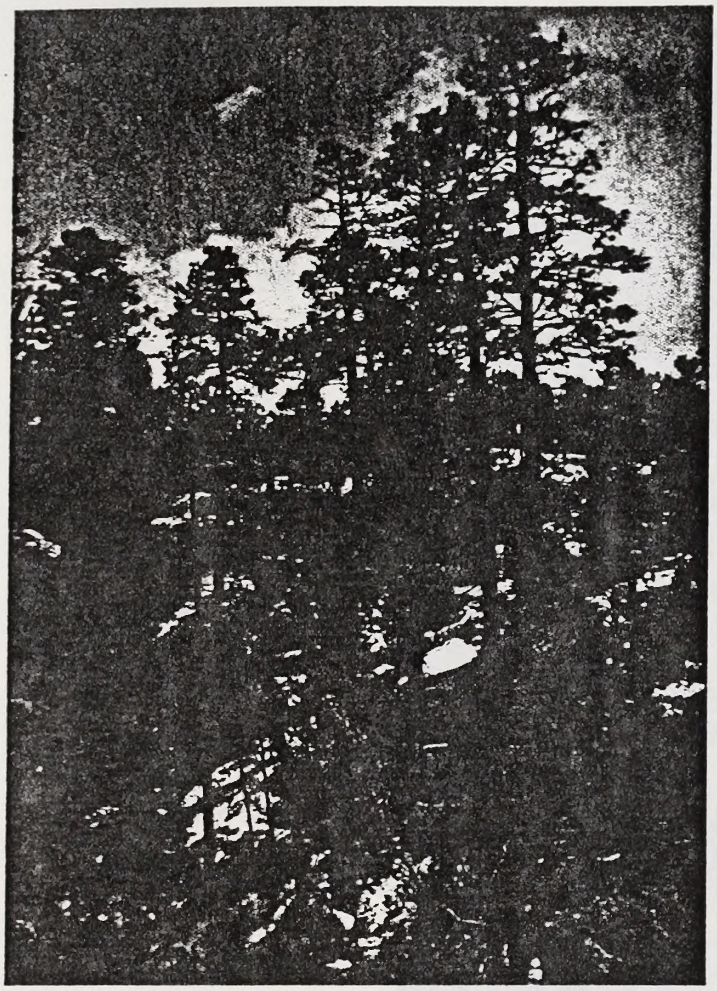


Figure 36 - Moderately used ponderosa (Site 14-C) in the Negro roost.

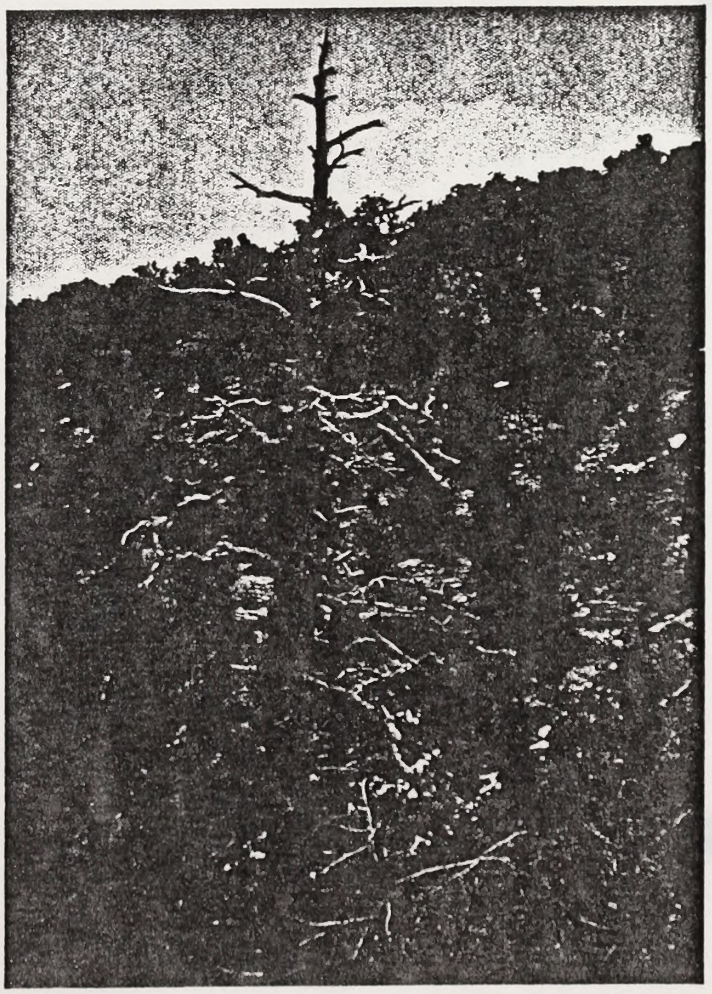


Figure 37 - Heavily used snag (Site 14-D) in the Negro roost.

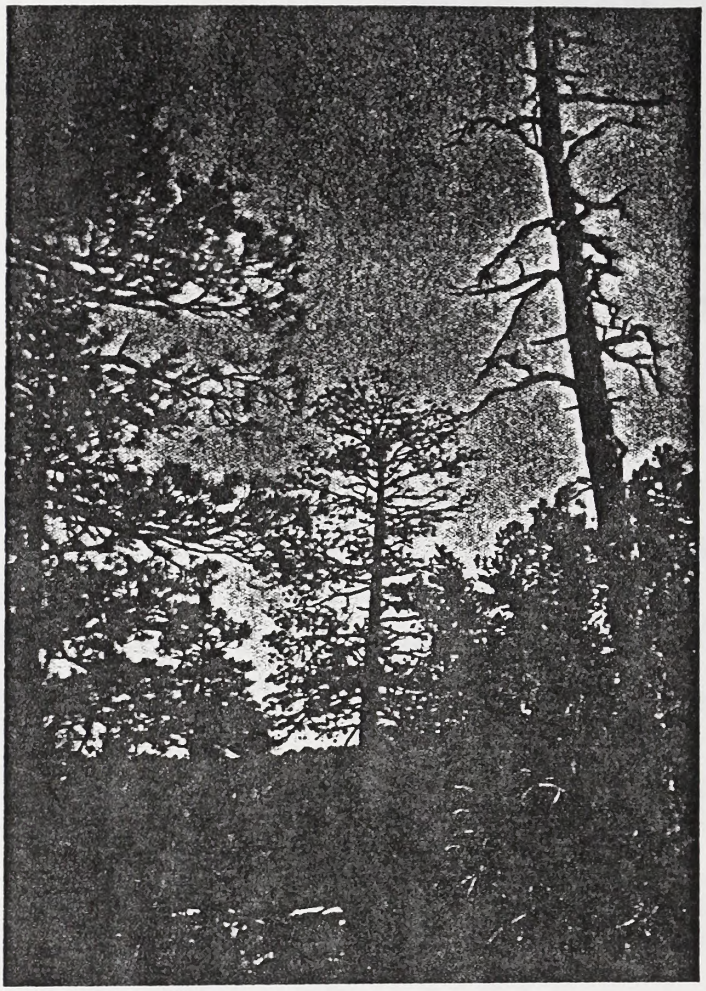


Figure 38 - Lightly used, live ponderosa (Site 14-E) in the Negro roost.

Perching

Bald eagles use diurnal perches for a variety of activities including feeding, hunting, loafing (sunning, preening, etc.), and social interaction (e.g., pre-roost staging area) (Coffey 1977, Grubb 1978, Servheen 1975). As mentioned in the foregoing section, many of the sites located during an attempt to identify roosts are probably just perches. Prey remains suggest feeding perches, while higher elevation, more exposed sites are better suited for daytime activity than nighttime protection. Observations from the past two winters in Arizona and New Mexico show an apparent trend in winter eagle use of dead, exposed trees near water for perching versus live, foliated, more protected trees for roosting (Grubb 1978). However, even though some potential roost sites located from the air can be identified as probable perching areas on the basis of physical evidence and site characteristics, it is not feasible beyond certain generalities to define bald eagle perching habitat for winter management purposes.

Prey availability and weather conditions certainly affect overall eagle distribution in any wintering situation (Servheen 1975, Steenhof 1976); and while doing so, these factors in combination with terrain and vegetational characteristics determine the types of perches used. Prey is felt to be the primary attraction, followed by suitable roosts within a reasonable distance, leaving diurnal perches as the most variable and relative of the wintering area habitat factors. Whether the higher locations used for perching are cottonwoods in a broad valley, dominant conifers in a forested situation, junipers on a hillside, or even rock ledges or outcrops on a ridge seems to make little difference. With

this in mind, along with the size of the area involved and number of perch sightings, no quantitative analysis of perches was conducted during this study. It was noted that eagles throughout the area were typically habitual in their repeated use of the same perches, even the same spot on a branch (Edwards 1969, Lish 1975, Stalmaster 1976). However, it is the author's contention that were those favored perches removed, the eagles would merely relocate to the next suitable branch or tree and exhibit the same habitual tendencies.

The population distribution shown in Figure 6A is the best indication of high, daytime use areas around Navajo Lake in 1979. Numerous perch sites were scattered throughout the areas of activity shown, while the variety of perches ranged from large, ridgetop trees to the lake ice. Bald eagles were seen perched in leafless mature cottonwoods, young saplings, live and dead ponderosa pine, Douglas fir, pinyon pine, and juniper. Trees varied from lone, ridgetop snags (Figure 39) to living, well foliated junipers in fairly dense hillside stands (Figures 40, 41). More protected roost areas were also apparently used for diurnal perching; the variety in tree type and location has already been described in the roosting section. Rocks or rock outcrops, particularly along a ridgeline or on a point, were also frequently used perches (Figure 42); although adults were less frequently noted than immatures on this substrate. Both age classes were seen on the ice, sometimes for no apparent reason (Figure 43); but more frequently they were standing near carcasses or along the ice edge proximal to a group of free swimming waterfowl. Away from the lake the range of tree perches was much the same, but cottonwood

was the most common perch tree where it occurred along the rivers or scattered through the open countryside (Figure 44). To exemplify the variability in eagle perches, on one occasion two adults were seen perched atop a haystack southeast of Durango.

In general bald eagles prefer high places with a commanding view of the surroundings (Stalmaster and Newman 1978, Steenhof 1978). Large snags or dead topped trees provide the openess for both accessibility and visibility (Spencer 1976). Similarly ridges, points, or other high ground are apparently favorite perching areas. There seems to be an inverse relationship between the use of low perches and either the relative elevation of the terrain or the amount of open country surrounding. Visibility is the key factor and serves both for spotting potential prey and potential threats. Limited by the pattern and stoutness of the branching, tree perches are usually (90%) in the upper half and concentrated in the top quarter (Stalmaster and Newman 1978). Two immatures in the lower Piedra valley (open country) seemed to be testing the size limitation of a vegetative perch by alternately using a sapling that barely supported an individual's weight. However, the eagles were feeding on an unknown bird at the time, so the choice of perches was apparently affected by the proximity of food. If an area is open enough to provide visual security and physical access, eagles will perch on the ground, rocks, logs, etc. (Figure 45), especially around a prey source such as a big game carcass. Steenhof (1976) has recorded a significant use of non-tree perches in feeding and food searching activity, while numerous other authors have noted the variability in low level perches (Cooksey 1962; Ingram 1965; Southern 1963, 1964; Shea 1973). However,

when foraging is complete the birds move to more typical, higher perching locations as available. Sun and wind are additional factors influencing perch use. Perches were often located where the eagles could loaf in the sun; or as along the east shore of the Pine Arm, they were atop a ridge where air currents and updrafts benefitted any flight efforts.

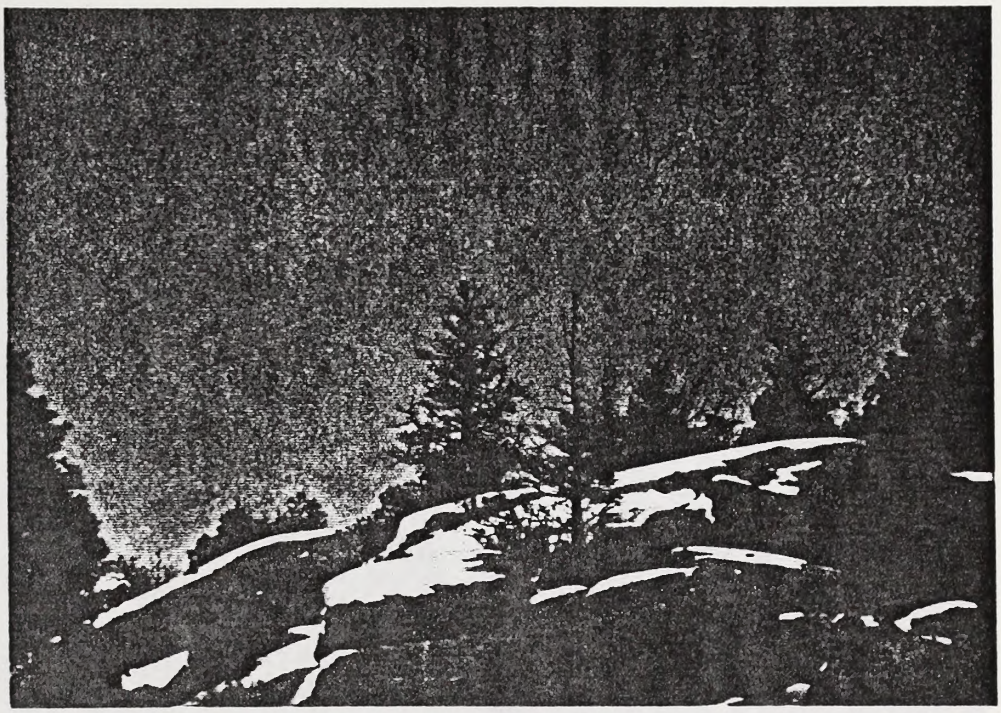


Figure 39 - Typical, ridgetop snag perch.

Figure 40 - Hillside perch in pinyon-juniper stand.

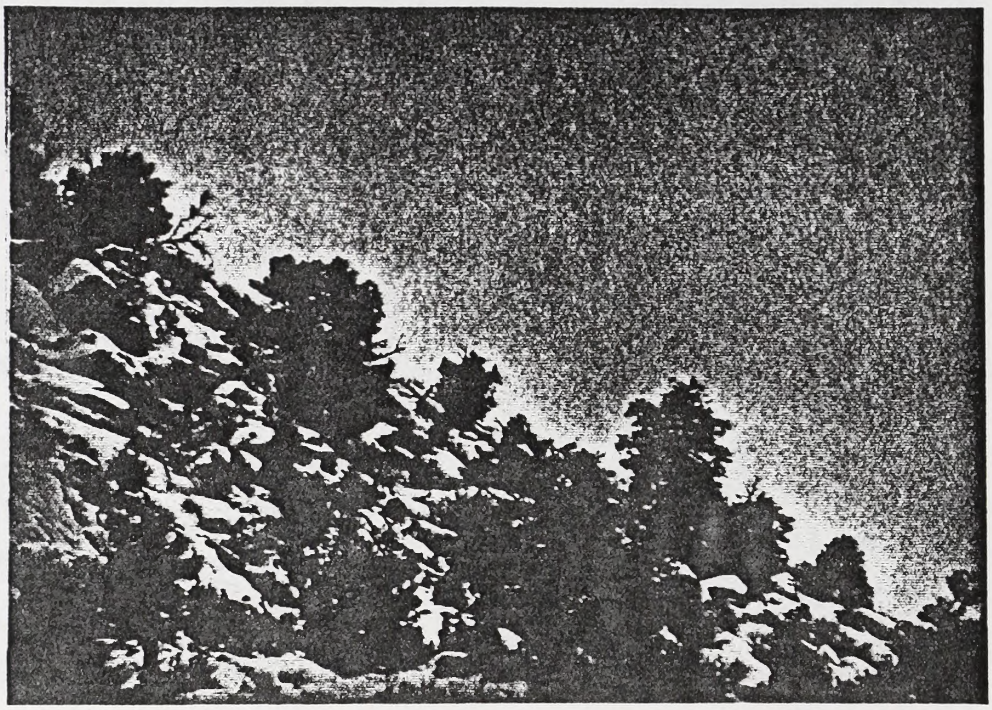


Figure 41 - Typical snag and live tree perch in pinyon-juniper stand along a ridgeline.

Figure 42 - Immature on a rock outcrop.

Figure 43 - An adult loafing on the ice.

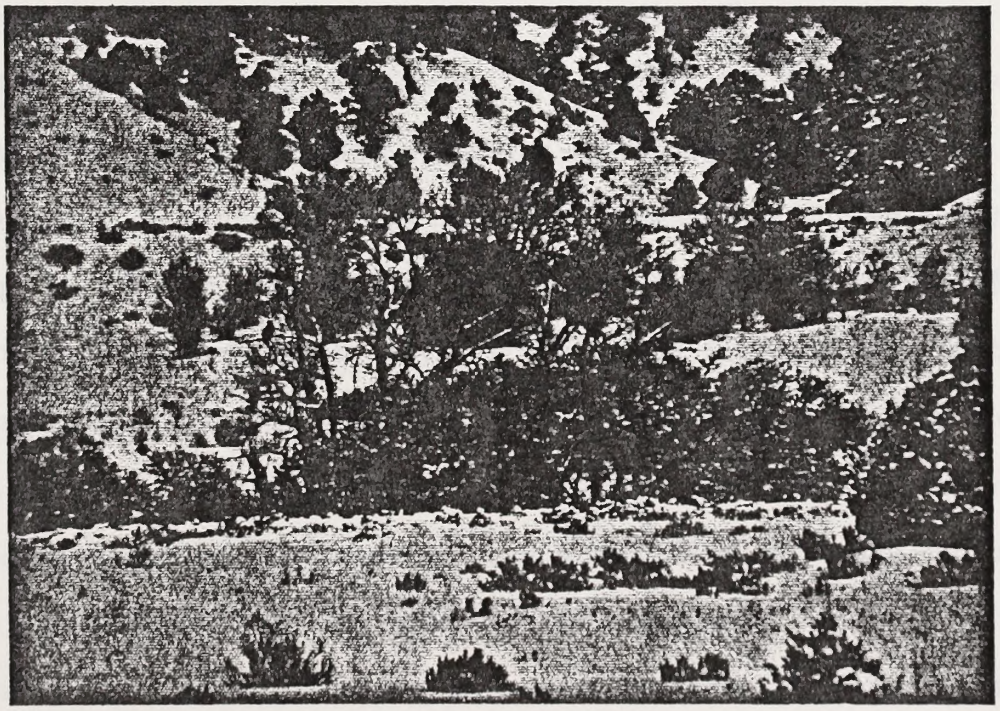


Figure 44 - Heavily used, cottonwood perch overlooking the Piedra valley.

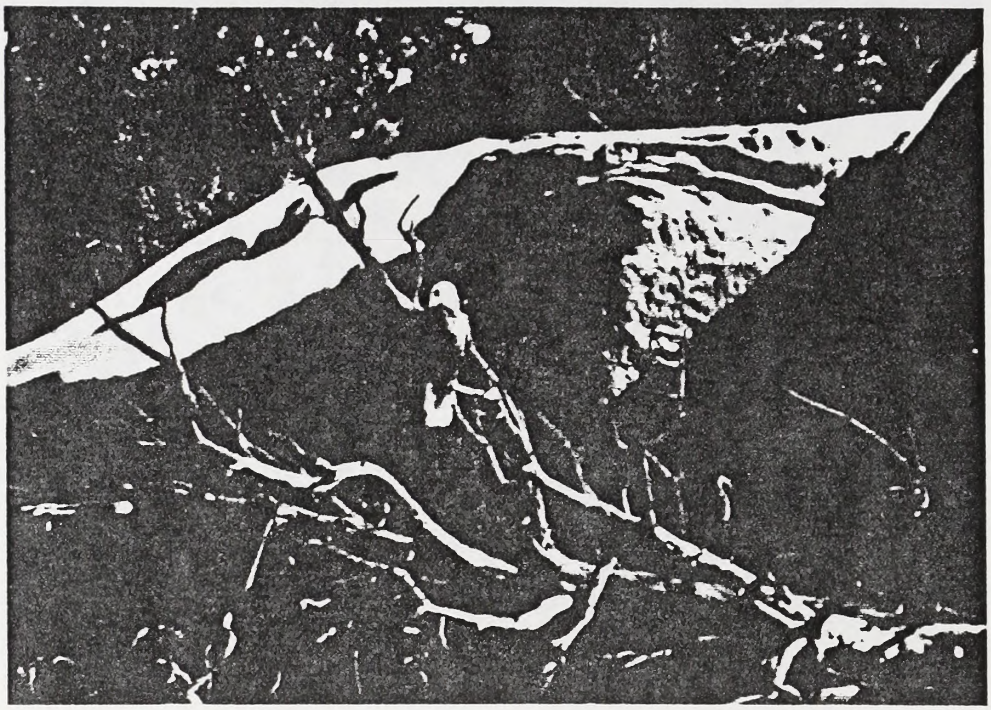


Figure 45 - A typical low perch, just off the ground.

Food Habits

Apparently bald eagles wintering at Navajo Lake in 1979 were feeding primarily on deer and elk carcasses with a secondary dependence on small mammals and waterfowl. Eagles were observed on or near large mammal carcasses on 37 separate occasions, on road-killed rabbits twice, and flying or perched near groups of waterfowl 14 times. Stoops at ducks were noted twice, while two other times an eagle was eating a prey item held in its talons. One of these appeared to be a dark bird, possibly a raven. Direct evidence of fish use was recorded only three times: twice in casting material at the Bancos and Negro roosts, and once an unidentified fish was seen in the grasp of immature flushed by the survey helicopter. There were seven other instances of eagles stooping to the lake surface in an apparent attempt to take fish, but since no success was observed the objective of such efforts can only be surmised from the absence of waterfowl in the vicinity (Table 6 and Appendix IV).

The Piedra-San Juan confluence at the north end of Navajo Lake is a major wintering area for deer and elk. It was not unusual to see 80-100 elk and numerous scattered mule deer along the Piedra during early morning or late evening eagle observations. With the exception of an open, relatively level area south of Arboles on the west side of the San Juan Arm there is little good deer and elk winter habitat along the lake to the south and in the Pine Arm. Occasional carcasses were observed on the ice or along shore of the San Juan Arm and its tributary canyons, but no concentrations of big game were ever evident.

Waterfowl, including mallards, gadwalls, pintails, goldeneyes, and mergansers were heavily concentrated just above Navajo Dam where rafts of several hundred were not uncommon. A complete list of potential

waterfowl species is given in Appendix V. Ducks were also common in large numbers near the Piedra-San Juan confluence and the flats south of Arboles along the west shore. Small groups were usually present in the major side canyons and along the scattered areas of good shoreline habitat when open water prevailed, but generally waterfowl were scarce along most of the San Juan Arm and almost nonexistent in the narrow, steep sided Pine Arm. Ice formation on the lake eventually seemed to concentrate much of the waterfowl in the open waters near the dam.

Unfortunately the abundance and availability of fish and small mammal food sources are not so easily detected by field observers. Brown and rainbow trout, kokanee salmon, largemouth bass, bluegill, and catfish are among the fisheries present in Navajo Lake that may be utilized by bald eagles. Obviously from Table 6, lagomorphs (rabbits and hares) were an important food source, but their relative availability to wintering eagles in the area is unknown. It is assumed this prey was actively hunted since evidence of more than occasional road or winter kills was lacking. In Utah, Edwards (1969) has described a technique of taking jackrabbits wherein several eagles are cooperatively involved in flushing and killing the live prey. Appendix V offers a list of small mammals that may occur in the area and that could conceivably be used by wintering eagles.

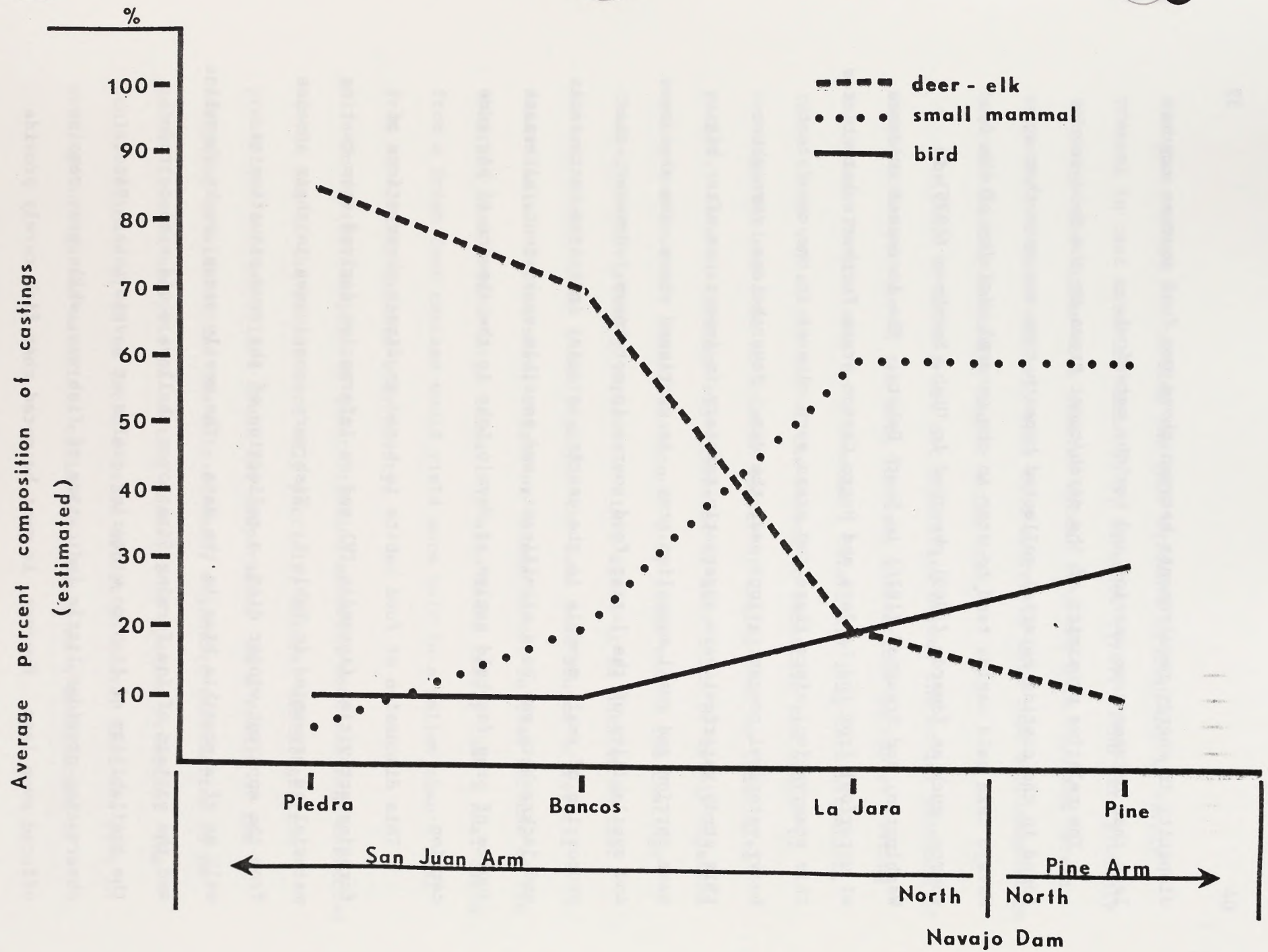
A total of 29 carcasses (19 deer, 4 elk, 1 hereford, and 5 unidentified) were noted over the study period at Navajo Lake, mostly at the north end of the San Juan Arm where big game wintering concentrations were typical (Figure 6C). These carcasses were for the most part along the lake shore, roads, or otherwise in the open, and can be considered only a portion of what was probably available in the area. For unknown reasons

some carcasses remained untouched while others disappeared quickly. One fresh deer carcass, apparently less than one day old, was found partially consumed on 10 February; four days later only the skeleton remained. There was no evidence of mammalian use; in fact only ravens or their sign were found around this carcass. Other fresh killed deer caught in fences or seen on the ice remained intact until frozen or snow covered. This variation in carcass or carrion utilization has been noted in other areas as an apparent result of fluctuations in alternative prey sources (Servheen 1975, Southern 1963).

Figure 6C shows the locations of deer and elk carcasses and waterfowl concentrations, while bald eagle roosts and/or perches where casting material was collected are indicated in Figure 6B. A comparison of this distributional information with the estimated composition of prey in casting material (Table 6) reveals several patterns in winter prey utilization at Navajo Lake (Figure 44). First the opportunistic nature of bald eagles is underscored by the variation in diet around the lake. (Because nearly all casting material was collected after the eagles left, no temporal pattern in prey use was documented.) Such variation has been noted throughout the eagle's winter range (Lish 1975, Southern 1963, Spencer 1976). As expected, the evidence of deer and elk utilization decreases with the distance from the known big game wintering areas. Yet, in those wintering areas at the north end of the San Juan Arm, bald eagles apparently fed very little on other mammalian or avian prey sources, despite the obvious concentration of the latter. Fresh carrion when available was apparently preferred over more energy expensive, live waterfowl. In Illinois, Southern (1963) noted live fish being preferred over fish carrion when both were available in quantity; however, the

Table 6. Amount (weight) and composition of casting material collected beneath roost and/or perch trees on Navajo Lake, 1979. Percent composition was derived from an ocular estimate of the amount of each prey class present (see text). A minimum of about 33% of the material collected from any area was analysed; up to 100% was studied on smaller samples.

Area	Material Collected (g)	No. of tree Locations	Estimated Composition	% Mammal/ % Bird
San Juan/Piedra	115.3	4	85% deer-elk 5% rabbit-hare 10% waterfowl	90/10
Bancos	1245.9	16	70% deer-elk 20% rabbit-hare 2% cattle 2% waterfowl 6% unknown bird	90/10
Nest tree	22.8	1	100% deer-elk	100/0
La Jara	48.4	2	60% rabbit-hare 40% waterfowl	60/40
Dick Earl	85.5	2	40% deer-elk 60% rabbit-hare	100/0
Negro	434.0	6	10% deer-elk 60% rabbit-hare 15% waterfowl 15% unknown bird	70/30



Variations in Winter Prey Utilization by Bald Eagles at Navajo Lake, 1979.

Figure 46

disparity in energy requirements between those two food sources may be less than between game carrion and healthy waterfowl.

The relative proximity of the perch/roost trees to the food source found in the casting material collected beneath them suggests that at Navajo Lake bald eagles tend to stay in the general vicinity of the food source, much as Edwards (1969) observed in Utah, Servheen (1975) in Washington, and Steenhof (1976) in South Dakota. The increased evidence of waterfowl from the La Jara and Negro Canyon areas further substantiates this observation, since these two areas were closest to the consistent, heavy waterfowl concentrations near the dam. Nevertheless, throughout this study waterfowl were apparently tertiary in importance after big game carrion and small mammalian prey. As mentioned above, the abundance and availability of the latter food source is not known. However, the proportion of small mammals in the casting material indicates cottontails and jackrabbits may be a significant, and possibly consistent, alternate source of prey for bald eagles at Navajo Lake in the absence of big game carrion.

This discussion of food habits is based on direct observations of foraging activities (Appendix IV) and on information derived from casting material as presented in Table 6. Fish were conspicuous in their absence from the apparent winter diet, a reflection of the true situation as well as of a possible bias in the data. The mostly steep, rocky shoreline and the pattern of ice forming first over shallows would seem to reduce the availability of fish to wintering eagles at Navajo Lake. Direct observation provided little indication of fish use, while prey remains offered even less. However, it must be noted that fish rarely provide

enough roughage for casting and thus evidence of fish use is rarely present in cast material (Lish 1975, Steenhof 1976). Fish were probably taken by bald eagles to a greater extent than the data reported herein suggest, yet it is unlikely this food source is more than supplemental to a predominantly mammalian and/or avian diet.

The data in Table 6 are not quantified beyond the ocular estimate of composition because of the many inherent limitations in raptor casting analysis. Particularly in a communal, relatively long-term situation, there is no way at the end of the season to ascertain the number of castings derived from an unknown number of eagles over an indefinite period. Several castings may represent as many birds or merely repeated use by one or two. Quantification of prey items within the castings themselves is virtually impossible since again it is unknown whether several identifiable items are from the same food source or several individuals. Furthermore, weight or volume cannot be used because of the inherent bias toward large items. It also seems likely that a meal taken from a fresh deer carcass would yield more hair in a pellet than a meal from an already exposed body cavity.

To further complicate quantification efforts, most castings collected at the end of the winter were only partials; natural disintegration prohibited a total pellet count for comparison. As a result of the foregoing considerations the only certain, objective information to be gained from an analysis of casting material is species presence. The ocular estimate given in Table 6 is an effort to convey what was seen in sorting through the materials collected. Based on a combination of

frequency and volume, it is a subjective approximation with all the inherent limitations. Nevertheless, this method did provide results compatible with field observations and expectations of food habits.

With avian scavengers, including the bald eagle, it is likely the amount of use after a carcass is broken open increases with use, i.e., the increasing activity of more birds renders more of the carcass available, and so on. The group itself also attracts more scavengers and over a period of time the location of a site is communicated through social interaction (Servheen 1976, Steenhof 1976). Mammalian predation and scavenging readily solve the avian problem of accessing the meat of an intact carcass, but at the same time mammalian activities leave much less food for the birds. On their own, ravens initially attack the eyes and anal area of fresh carcasses. There was some indication that eagles keyed on raven activity and may not have pioneered new, intact carcasses themselves; however, conclusive data are lacking.

Certainly bald eagles with their opportunistic nature (alternative food sources) and communal wintering habits (communication) are well suited for winter carrion utilization. However, it would seem advantageous for a generalist like the eagle to key on a scavenging specialist such as the raven whenever circumstances like those at Navajo Lake permit. In Illinois raven feeding activity often attracted wintering eagles to the food source (Southern 1964). As the winter terrestrial dependence of bald eagles becomes more evident through carrion and small mammal foraging, the interspecific relationships with other more specialized predators or scavengers should be scrutinized.

Behavior and Related Observations

General

Wintering bald eagles at Navajo Lake showed typical diurnal patterns of activity (Edwards 1969; Grubb 1978; Servheen 1976; Southern 1963, 1964; Steenhof 1976). Movement to and from the roosts occurred at dusk and dawn, respectively; however, on several occasions, birds were seen flying into roosts after total darkness, much later than originally expected. During inclement weather they were earlier to roost and later coming off, occasionally remaining in the area all day. Also, there was less activity or movement observed through the day when cold, snowy, or overcast conditions prevailed. The perches and use areas frequented during these conditions were usually lower and more protected. As an example, on 22 January two adults left their exposed perches on the lake ice in immediate (<3 minutes) and apparent response to an abrupt snow squawl with gusty winds. Moderate winds on nice days often led to increased soaring activity, particularly along ridgetops where updrafts occur. Except for the evening staging activity in the Piedra area, no definitive patterns of daytime foraging or loafing were noted. Eagles were seen on or near food sources throughout the day. With at least the early abundance of carcasses they apparently could eat whenever so motivated.

The distribution of carrion or potential prey largely accounted for the pattern of eagle use around the lake. Eagles spent their loafing hours relatively near their food source. Observations of eagles perched overlooking groups of waterfowl or near carcasses were numerous. Food habits material collected from beneath roosts indicated localized foraging efforts, i.e., eagles tended to roost and forage in the same portions of

the lake. It is not known whether the same eagles worked different parts of the lake over time or if there may have been relatively discreet subpopulations. There was a tendency of eagles to frequent areas of open water as the lake ice increased. Particularly on the upper Pine Arm, birds were usually seen in the vicinity of the ice-open lake interphase. As the lake became more frozen the eagle population decreased.

Data are limited but there is some indication that when forced by either ice or a lack of food, lake birds may have dispersed and adapted to a more terrestrial existence. On the 6 February flight when the numbers on the northern San Juan Arm were noticeably reduced, nine eagles were counted southeast of Ignacio. Most sightings away from the lake were of scattered individuals, probably as a result of more competitive, wider ranging foraging efforts and a reduced prey base. There were many individual sightings around the lake, but the majority of birds seen were loosely associated in small groups, i.e., several eagles perched along the same hillside or section of lake. Soaring was a common group activity. On actual flights, particularily to or from roosts, there was a distinct tendency to follow the terrain rather than fly over the top of topographic features. The lake itself, side canyons, saddles, etc., were flown consistently, and predictably after some observation time.

Inter- and Intra-Specific Interactions

Ravens and bald eagles were virtually constant companions in the Piedra-San Juan area probably because of their mutual dependence on carrion. The consistant, initial presence of ravens at big game carcasses implied that eagles might be keying on them to locate this food source. Whether coincidence or a demonstration of similar flight requirements,

predator/hazard avoidance, or prey locating behavior, it is interesting to note that on several occasions when a raven flew into a carcass and was followed by an eagle, the latter flew to the carcass along the same flight path as the raven. While feeding or perched, ravens seemed to respect the eagles' dominance; no conflicts were observed. Frequently the birds were seen perched in the same trees, sometimes within a few feet of each other. Roosting patterns of both species seemed related physically and temporally. A large raven roost was found in a dense stand of pinyon-juniper on the hillside just above the Bartlett roost. From the Piedra staging area ravens consistently departed in the evening about a half hour prior to the eagles. Observations at the roost showed that the majority of ravens arriving from the Piedra and various other directions were settled into their hillside roost before eagles begin to assemble in the large trees of the drainage below. Ravens were also seen flying, apparently toward an evening roost, in Negro Canyon but no specific site was located there.

Occasionally golden eagles (Aquila chrysaetos) were observed soaring with balds above the San Juan valley. Sometimes a few ravens were part of the group. Once when an immature bald joined three soaring golden eagles, one of the latter flew close to the immature several times and presented its talons. However, the group remained together and eventually soared out of sight in the distance. On another occasion three soaring redtails showed agression toward an adult and immature bald eagle passing through the same airspace, but no contact was made.

No unusual or profound observations of intra-specific behavior were made during this study. In general adults seemed to dominate immatures, particularly on perch displacement. Rivalries between immatures with

food items were not uncommon; but for the most part little conflict was evident, perhaps because of the abundant food base. The observed perch displacement, vocalizations, and staging activity associated with roosting have already been mentioned.

Disturbance Factors

Bald eagles at Navajo Lake responded differently to various levels of disturbance. The Piedra staging area was situated between a paved state route and a well travelled gravel road (Figure 7). The eagles there showed no response to passing vehicles, and rarely reacted to vehicles that slowed or parked within 200-300 yards. Stalmaster (1976) found auto traffic one of the least disturbing human activities affecting wintering eagles. An approach on foot from a parked vehicle usually caused the eagles to relocate. The same tolerance of traffic wherever eagles perched near roadways was evident, but generally when a vehicle stopped nearby the birds became noticeably alert and ready to fly at the least noise or sudden movement. Perched eagles near roads seemed to tolerate more disturbance than birds feeding on carcasses approximately the same distance from the road. Once along the upper San Juan valley, the observers' parked truck nearly 1/4 mile from a carcass was believed to have kept three eagles from feeding there.

The surroundings also affected bald eagles' tolerance or reaction distance (Stalmaster and Newman 1978). As expected, birds on the ice were quickest to fly at the greatest distance from a potential disturbance; 350-400 yards was typical. Boating traffic seemed to have little effect on eagles perched above the shoreline, while birds first seen on the ground or rocks along the water's edge reacted much sooner. Typically

boaters could pass or even stop within 50-100 yards of eagles perched upslope with no apparent affect; however, sudden noise or movement would usually cause flight. Once so disturbed and relocated, an eagle would become much more responsive to any continued harassement with increasing reaction distance and subsequent flight. Overall, highway traffic and boating activity are felt to have minimal impact on wintering bald eagles around Navajo Lake.

No direct harassment of the eagles was observed in the area. Most residents accept them as part of the winter landscape like the deer and elk herds. Gunshots were heard in the Piedra area twice, but there was no indication eagles were the targets. Once someone stopped near the staging area and fired a carbide cannon at the elk. Bald eagles in the vicinity left and did not return that day. As mentioned earlier, low flying helicopters frighten virtually all eagles into flight; however, the birds usually circle away from the aircraft and land in the same area after aircraft has passed. Perhaps the audio-visual stimulus puts the disturbance in better perspective for the eagles than an unseen noise, which at least in this comparison had a more significant impact.

Severe winter weather can reduce both visibility and the eagles' tendency to fly. Harsh conditions can also affect prey availability, which in turn causes variations in the eagles' reactions. Later in the season when carcasses were less abundant, feeding eagles were less easily disturbed from their food source. It would also seem probable that eagles at a newly discovered carcass would be more alert and responsive to disturbance than when feeding at an already familiar food source. Throughout the range of disturbance observations, adults were more easily frightened

than immatures, a fact that corresponds to the documented increase in sensitivity with age (Stalmaster and Newman 1978).

Most of the observed eagle activity around Navajo Lake was along the shoreline or immediate vicinity, which is part of the reclamation and water power projects withdrawal holdings. As such, these use areas would seem secure. The roost sites discovered involve mixed ownership. Bartlett roost (NE,10,32N,5W, Colorado) north of the Piedra-San Juan junction lies on Southern Ute Indian Reservation with private land adjacent to the south and east. The Bancos site (SE,35,32N,6W, New Mexico) appears to straddle the Reclamation-BLM boundary north of that canyon. The Negro roost (NE,11,31N,8W, New Mexico) apparently lies entirely on BLM land but immediately adjacent to a state owned section (2,31N,8W) to the north. No direct or impending disturbance was noted in any of these areas, although some pipeline maintenance roads and storage tanks were located about a mile west of the Negro roost area.

Beyond the lake, data are too limited to assess disturbance factors or the effects of various land management practices on wintering eagles. Eagles seen in the Piedra-San Juan valleys and along the San Juan Arm may be ranging inland to feed on big game and wild horse carcasses that occur at higher elevations, particularly to the east. Such activity would involve Forest Service ownership and potential logging practices. At this point, however, it can only be recommended that wintering eagles be considered on a case by case basis when any significant development or changes in current land management practices are proposed.

Recommendations

At a minimum, the wintering population at Navajo Lake should be monitored through aerial surveys in subsequent years. The number of flights will depend on the funding available. Although unrealistic, a weekly helicopter survey would optimize the results, with a single fixed-wing flight in January being the other end of the spectrum. Whatever flights are possible should be spaced through the period of November to April, with emphasis given to the midwinter high in January and early February. Whenever possible a helicopter should be used. Regardless of aircraft, a standardized flight path around the lake would be useful in analysing data, particularly when collected by different agencies or individuals.

To remove bias from ground sighting information, four data analysis areas were defined after the field season by the normal amount of area covered in one day's activities. Future ground efforts should be planned with these or similar sub-study areas in mind. Again, definite routes and times for area surveying would facilitate comparisons. In addition to the survey and ground observation efforts, the association of ravens and wintering eagles should be studied further. Perhaps the ravens' activities, particularly when heading to roosts, will provide a supplemental technique for locating eagle use areas and defining habitat needs.

The extent and distribution of the inland eagle population around Navajo Lake should be determined, which may prove to be a study in itself. Flying or driving a grid pattern in the area would be one approach to numbers and distribution. Observing the scattered individuals at length and trying to follow some of them would probably yield the best results, although such efforts would be extremely time consuming.

However, locating foraging and/or roosting areas would provide a better estimate of numbers and needs. Organization of local birding groups and coordination with the Christmas bird counts might also help in this endeavor. At present there is no way of knowing how the lake and terrestrial populations interact, if at all; it is possible the use of surrounding upland habitat may influence activity at the lake, or vice versa.

More effort is needed to fully evaluate the roosts located in 1979. Blind or time-lapse camera observations are necessary to determine actual numbers of birds using the roosts, and the variations that may occur through the season. Collecting fresh castings or stratifying casting material by placing successive, plastic drop cloths beneath the roosts periodically might be helpful in relating casting material to numbers of eagles over time. Consistent perches should be noted and checked for casting material, in an effort to differentiate roosts from perches using such material. Also the potential roost/perch sites identified during the 1979 study should be observed more closely to determine diurnal and nocturnal use.

Carcasses and other live prey species should be monitored closely, noting not only occurrence, but numbers, distribution, and duration of availability. Time-lapse photography would facilitate carcass studies. The small mammal population being utilized by wintering eagles at Navajo Lake also needs to be described. This was obviously a significant portion of the eagles' diet in 1979, yet essentially nothing is known about where, when, or how such prey is taken. In subsequent years the

pattern of prey utilization will certainly vary, probably to less obvious sources during more critical years. Thus it is mandatory for long-term management to understand the full spectrum of winter food habits.

Short-term color marking (wing windows, tail painting, etc.) and temporary radio telemetry devices (tail transmitters) are two techniques that would greatly facilitate efforts to determine movements and activities away from lake, around the lake, and locally within given areas. These techniques would also permit accurate documentation of how these functions vary with lake ice, weather, and prey changes. If applied, these techniques should be used with caution and only by knowledgeable personnel.

From a management standpoint, the results of the 1979 field season point to a relatively secure, maintenance free wintering population. The three roost areas should certainly be protected, along with the other identified use sites and areas of concentration along the lake shore. One long-term consideration is the regeneration of roost tree species such as ponderosa pine, Douglas fir, and cottonwood in suitable or established roosting areas. When the patterns of prey utilization are better understood, it may be feasible to manage for certain prey species beneficial to wintering eagles. In the meantime, Navajo Lake and the surrounding area must be considered prime winter eagle habitat; any development or changes in land use should be weighed against the possible effect on the bald eagles in the area.

SUMMARY AND CONCLUSIONS

Numbers and Distribution

1. The minimum bald eagle population at Navajo Lake between November 1978 and April 1979 varied between 15 and 77, with an average of 35-40.
2. The population peaked in early January and again to a lesser extent in late March. These peaks fell on either side of the maximum ice buildup at the lake.
3. The overall adult:immature ratio was 40:60 with the adults arriving and departing earlier. However, through January and early February, both age groups were about equally represented and numbers fluctuated similarly.
4. Survey data indicated more immatures in the Piedra and Bancos areas (40:60) then in the La Jara and Pine areas (50:50) to the south and west, possibly as a result of differential prey distribution.
5. The Bancos area of the San Juan Arm showed consistent use by the highest number of eagles through the study, followed by the Pine, Piedra, and La Jara areas.
6. Scattered eagles were consistently seen away from the lake but total population data are lacking.

Roosting

1. Through aerial habitat surveys and ground observations of eagle activity, three communal winter roosts were located: Bancos Canyon, Negro Canyon, and the Piedra-San Juan area (Bartlett roost), in order of apparent importance.

2. Eleven other potential roosts/probable perch sites were located and described, primarily on the San Juan Arm and its tributaries.
3. Ponderosa pine was the most frequent roost tree, followed by Douglas fir and cottonwood. Both live and dead trees showed use, and there were normally several high use trees in each area.
4. All known and most suspected roosts were in low lying, protected clumps of large trees. Negro and Bartlett were about a mile from the lake.
5. Evening flights into a roost varied from near sunset until after darkness, with most eagles entering a communal roost separately at varying time intervals. Eagle flights into the Bartlett roost were regularly preceded by ravens roosting nearby.
6. Specific flight paths into the roosts were identified at both the Bartlett and Negro sites.
7. Casting material found under the roosts and the distribution of known prey sources indicated the Navajo Lake eagles were roosting and foraging in the same vicinity.

Perching

1. Bald eagles were observed to use a wide variety of perches (live and dead trees, rock outcrops, lake ice, fallen logs, etc.). Live trees with dead tops or exposed branches and snags along the lake or adjacent ridges were favored perches.
2. Generally, eagles preferred high places with a commanding view of the surroundings. An inverse relationship was evident between the use of low perches and either the relative elevation of the terrain or the amount of surrounding open country.

3. Proximity to food sources and roosts apparently determined the loafing or perching areas used by wintering eagles at Navajo Lake.

4. Specific perches were used consistently and more protected ones were chosen during inclement weather. However, perching habitat was not thought to be critical or limiting for eagles wintering in the Navajo Lake area.

Food Habits

1. During 1979 big game (deer and elk) carrion was the primary food source for wintering eagles in the area. Small mammals (mostly lagomorphs) were second in importance, followed by waterfowl and fish.

2. Prey utilization showed a patterned variation around the lake from the northern San Juan Arm, to the dam, and up the Pine Arm. In this progression, evidence of big game carrion decreased while small mammals and waterfowl increased in apparent importance.

3. Where carrion was available, it seemed to be preferred over live waterfowl, which certainly required a greater energy expenditure to obtain. Eagles apparently concentrated on the most abundant prey source but retained the flexibility to vary the diet as conditions changed.

Behavior

1. Foraging was observed throughout the day at Navajo Lake, while movement to and from roosts at dawn and dusk was more typical of other wintering areas.

2. Through the winter there was a tendency to frequent areas of open water, with the major ice-water interphases appearing to be favored locations.

3. Lake eagles may be dispersing to surrounding upland habitat during the winter. Terrestrial occurring birds appeared less gregarious through the day and more widely scattered than around the lake.

4. In some areas, eagles showed consistent flight patterns, especially to and from the Bartlett and Negro roosts. The birds tended to follow the terrain and avoid flying over large topographic features.

5. Ravens and bald eagles were constantly seen together in the Piedra-San Juan area where they shared the food resource, perches, and roosting area. Ravens often preceeded eagles at fresh carcasses and always headed off to roost prior to eagles in the same area. Similar winter requirements and/or a significant relationship is implied.

6. No unusual or significant aspects of intraspecific behavior were noted. Adults seemed to dominate immatures, but conflicts were minimal within or between age groups.

Disturbance

1. No significant disturbances, direct or impending, were noted at Navajo Lake during the 1979 winter months.

2. Most eagle activity was observed on Bureau of Reclamation land around the lake itself. The three roosts also involved BLM, Southern Ute Indian Reservation, State of New Mexico, and private ownership.

3. The eagles seen perched near roadways were apparently undisturbed by passing traffic, although slowed or stopped vehicles usually elicited a nervous response or flight.
4. Eagles feeding on carcasses appeared more easily disturbed than when perched and loafing. Similarly, eagles on the lake ice were quickest to fly when disturbed.
5. Boating traffic had little effect on eagles perched above the shoreline, and this technique permitted the closest approach to the birds.
6. All observations indicated that the adults were more responsive to disturbances than immatures, i.e., they reacted at greater distances and flew further from the source of irritation.

Recommendations

1. Continue to monitor the Navajo Lake winter eagle population with as many aerial surveys between November and April as feasible.
2. Determine the numbers, distribution, and wintering habits of eagles seen consistently inland from Navajo Lake.
3. To better evaluate the roost sites located in 1979, determine the numbers of eagles using each site along with variations through the season. Diurnal and nocturnal activity should also be checked at the other potential roost/perch sites identified.
4. Pursue the standardization and quantification of casting material as an assessment of eagle food habits, intensity of use, and possible differences in roost and perch sites.

5. Better document winter prey utilization through monitoring carrion and live prey species' numbers, distribution, and duration of availability. Special attention should be given to the important but little known use of small mammals.
6. Conduct studies to better define local, around lake, and off lake movements and activities, on a daily and seasonal basis in response to weather, ice, and prey base changes.
7. Continue current land management activities, which apparently have little or no impact on wintering eagles at Navajo Lake; however, protect the roosts and other high use areas from any future detrimental changes.

Conclusions

1. Navajo Lake, with its abundant and varied prey base, is an important bald eagle wintering area.
2. In response to weather conditions and prey availability, the population numbers and distribution vary around lake within any given season, and probably from year to year.
3. Habitat does not appear to be limiting, but at least the three roost areas identified should be considered critical.
4. No immediate management action is necessary to maintain this winter population, primarily because of the season and subsequent inaccessibility. However, it is recommended that wintering eagles be considered on a case by case basis whenever any significant development or changes in current land management practices are proposed in the area.

5. By its very existence and with the research effort already invested, the winter bald eagle population at Navajo Lake provides an excellent opportunity for continued study to better understand winter habitat and management needs.

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APPENDIX I

Winter bald eagle data recording forms:

Daily Sighting Summary

Field Map (BLM, 1/2 inch = 1 mile)

Habitat Evaluation

Habitat Description (long form, Grubb 1978)

DAILY BALD EAGLE SIGHTING SUMMARY

Date _____ (year, month, day) Forest _____

Observers _____

Total observation hours (sum of team members' times) _____

Weather: Temp (approximate, nearest 10° or range) _____
Wind (circle one) - calm, light, moderate, strong
Clouds (circle one) - clear, partly cloudy, overcast
Precip (circle one) - rain, snow, other _____

*Activity: 1. flying - active flight with direction
2. soaring - little/no wing movement, circling
3. perching - daytime, ground, tree, etc.
4. roosting - overnight perch
5. feeding - consuming or chasing prey

Time (24hr)	Location ¼S,S,T,R	Description (name, etc.)	No. of Eagles A I U(I/GE)	Activity*	Comments (flight direction)

Subtotals ___A ___I ___U

Total _____

STANDARD
PARALLEL
Tiffany
Haystack Mtn.
Arboles
Allison
Boca
Middle Mesa
TIFFANY PEAK
COUNTY
COLORADO
ARCHULETA
Carracas
PINE RIVER
BURNT MESA
7012-A
7011-B
7011A
7012
7011
7010B
7016
7015
7014A
Earl Canyon
Slater
CARSON NATIONAL FOREST
DISTRICT
SAN JUAN
Lopez Lake
Manuel
Fragua
Espinosa

WINTER EAGLE HABITAT EVALUATION

Observers_____
Date_____
Location_____
¼S,S,T,R_____
Reference Map_____

Water
Distance_____
Direction_____

Terrain
Slope_____

Aspect_____

Sketch X-section----------

Exposure_____

Ground Cover_____

Brief description:

Stand

No. of mature tree by species_____&_____
_____

Crown density_____

Avg. height_____Avg. DBH_____

Snags present?_____Describe_____

New growth?_____

Roost Trees

Type evidence_____

Species_____Height_____DBH_____

Condition_____

Items collected/Observed

Type_____Container NO._____

Amount_____

BALD EAGLE WINTER HABITAT DESCRIPTION

Observers _____ Forest _____

Date _____ (year, month, day) Period Observed _____

Type area: 1. roosting 2. perching/loafing 3. feeding (circle one)

Name/description _____ No. _____

Location _____ (¼S,S,T,R) Reference map _____ ID no. _____

Aerial photo no. _____ (Sketch area map on back of form)

Eagle Use

Extent of use:

Date	No. eagles A	I	U	Time Period	Comments

Type of use: 1. roosting 2. perching/loafing 3. feeding (circle one)

Food source: 1. fish 2. waterfowl 3. carrion 4. other _____ (circle one)

Species _____ Estimate nos./abundance _____

Food items noted or collected _____

Other raptors: Species _____ Numbers _____

Water

Distance _____ (yards or miles) and direction _____ from use area.

Type: 1. river 2. stream 3. lake 4. reservoir 5. other _____ (stock tank, sewage pond, etc.) (circle one)

Ice: 1. open 2. partly frozen 3. frozen over (circle one)

Flow: 1. still 2. slow 3. fast (circle one)

Level: 1. low 2. normal 3. high (circle one)

Beach type: 1. rocky/sandy 2. boulders 3. cliff/canyon 4. overgrown vegetation 5. frozen over (circle one)

Terrain

Slope: 1. level 2. moderate 3. steep 4. cliff (circle one)

Aspect/exposure: 1. N 2. NE 3. E 4. SE 5. S 6. SW 7. W 8. NW (circle one)

Protection from wind: 1. none 2. some 3. sheltered (circle one)

LOS protection from human activity: 1. none 2. some 3. sheltered (circle one)

Cliff perch: cliff height _____

distance of perch below top _____

Stand

Species composition (species/percent) _____

Coniferous/deciduous: 1. 100/0 2. 75/25 3. 50/50 4. 25/75 5. 0/100 (circle one)

Continuity: 1. continuous 2. broken (openings >50%) 3. isolated (circle one)

HABITAT DESCRIPTION - 2

Observers _____ Forest _____

Date _____ Name/description _____

Number of trees if countable _____

Crown density: 1. thin (0-40%) 2. moderate (41-70%) 3. dense (70%+) (circle one)

Number _____ and/or percent estimate _____ of snags.

Regeneration of roost/perch trees: 1. evident 2. absent 3. undetermined (circle one)

Roost/Perch Trees

Location in stand _____

Species _____ Height _____ DBH _____

Condition: 1. all dead, top intact 2. all dead, top broken 3. living, top broken 4. living, top intact but dead 5. all living, top intact (circle one)

Branch location in crown: 1. upper 1/3 2. middle 1/3 3. lower 1/3 (circle one)

Perch location on branch: 1. outer 1/3 2. middle 1/3 3. inner 1/3 (circle one)

Disturbance Factors

Eagle responses: 0. no visible signs exhibited 1. head movement, changes position, appears nervous 2. aborts or changes flight direction 3. leaves site, lands in close proximity 4. leaves site, lands in perching area 5. leaves area, returns within 4 hours 6. leaves area, returns after 4 hours same day 7. leaves area, returns after 8 hours same day 8. leaves area, returns following day 9. leaves area, returns within period of use 10. leaves area and does not return

Noise level: 1. low 2. moderate 3. high

Permanency: 1. temporary 2. seasonal/reoccuring 3. permanent

Degree of habitat change: 1. none 2. light 3. moderate 4. severe

Probable effect on eagle activity: 1. none 2. light 3. moderate 4. severe

Type	Response	Distance	Direction	Noise	Permanency	Change	Effect

Weather

Date _____ (year, month, day)

Time	Temp (°F)	Wind (mph)

Use area

100 yards distant

200 yards distant

APPENDIX II

Summary of weather observations on temperature, precipitation, and wind recorded at Navajo Dam, New Mexico (National Weather Service data).

Month	Day	Temperature Max.	Temperature Min.	Precipitation (inches)	Wind 24 Hour Movement (miles)
Jan	1	32	6	0	0
	2	44	8	0	176
	3	21	8	0	38
	4	30	7	0	41
	5	39	21	0	35
	6	32	18	0	0
	7	30	8	0	0
	8	39	10	0.36	80
	9	38	9	0	35
	10	38	10	0	23
	11	40	15	0	24
	12	40	22	0	33
	13	39	15	0	0
	14	32	8	0	0
	15	38	7	0	57
	16	42	28	0	14
	17	43	33	0.06	24
	18	45	31	0.28	56
	19	48	30	0.20	20
	20	31	10	0	0
	21	32	13	0	0
	22	40	15	0.08	86
	23	51	5	0	70
	24	28	5	0	39
	25	34	6	0.03	36
	26	36	18	0.17	27
	27	29	0	0	0
	28	26	2	0	0
	29	36	5	0.25	110
	30	25	-7	0.03	37
	31	20	-1	0	29
Feb	1	30	3	0.17	29
	2	35	18	0.10	29
	3	32	-4	0	0
	4	32	-6	0	0
	5	33	-1	0	77
	6	35	5	0	19
	7	36	6	0	38
	8	36	7	0	39
	9	42	10	0	48
	10	44	10	0	0

Month	Day	Temperature Max.	Min.	Precipitation (inches)	Wind 24 Hour Movement (miles)
Feb	11	43	12	0	0
	12	47	9	0	81
	13	50	19	0	40
	14	55	22	0	76
	15	55	25	0	40
	16	52	23	0	62
	17	42	20	0	0
	18	50	22	0	0
	19	40	16	0	0
	20	52	19	0.05	174
	21	52	29	0.06	43
	22	40	23	0.22	25
	23	37	24	0.06	40
	24	43	15	0	0
	25	46	20	0.09	0
	26	45	17	0	128
	27	48	29	0.03	29
	28	45	22	0	36
Mar	1	47	25	0	44
	2	47	29	0.09	35
	3	37	20	0	0
	4	38	14	0	0
	5	47	18	0	135
	6	46	22	0	48
	7	52	25	0	55
	8	57	30	0	62
	9	62	28	0	33
	10	46	18	0	0
	11	48	20	0	0
	12	57	21	0	174
	13	57	27	0	58
	14	60	31	0	57
	15	60	36	0.09	40
	16	55	35	0	44
	17	56	32	0.25	0
	18	40	26	0	0
	19	60	29	0	107
	20	59	32	0.08	59
	21	59	32	0.40	44
	22	59	30	0.22	19
	23	60	27	0	44
	24	59	27	0	56
	25	55	29	0	41
	26	58	28	0	42
	27	64	35	0	54
	28	60	39	0	23
	29	57	31	0.20	46
	30	45	30	0.01	32
	31	56	32	0.27	0

Month	Day	Temperature Max.	Temperature Min.	Precipitation (inches)	Wind 24 Hour Movement (miles)
Apr	1	40	26	0	0
	2	55	23	0.27	127
	3	55	26	0	35
	4	55	24	0	45
	5	50	30	0	66
	6	64	35	0	46
	7	73	34	0	0
	8	66	34	0	0
	9	71	34	0	157
	10	57	38	0.25	35
	11	42	31	0.13	67
	12	42	27	0	83
	13	48	26	0	42
	14	60	34	0	0
	15	72	38	0	0
	16	74	34	0	155
	17	77	45	0	42
	18	75	40	0	45
	19	74	39	0	48
	20	61	32	0	49
	21	69	39	0	0
	22	68	39	0	0
	23	75	35	0	163
	24	75	44	0	45
	25	69	41	0	38
	26	67	44	0	51
	27	66	43	0	41
	28	71	44	0	0
	29	70	45	0	0
	30	70	44	0	141

APPENDIX III

Summaries by area showing numbers of days and sightings in each section, expressed as percentages and multiplied to form a use index figure. Headings are intepreted as follows:

No. of Sections	-	Number of sections in area
No. Days (local)	-	Number of observation days in area
No. of Days	-	Number of days eagles seen in section
% All Days	-	Number of days eagles seen in section divided by 39(the total number of days eagles were recorded throughout study with all areas combined) times 100
% Local Days	-	Same as above except No. days (local) is divisor
No. Sightings	-	Number of sightings in section
% Sightings	-	Number of sightings in section divided total sightings in area times 100
Product 4*6	-	Whole number product of % Local Days and % Sightings

The index figures in the last column were used to plot Figure 6A.

PIEDRA NO. OF SECTIONS = 31 NO. DAYS(LOCAL) = 32

	NO. OF DAYS	% ALL DAYS	% LOCAL DAYS	NO. SIGHTINGS	% SIGHTINGS	PRODUCT OF 4*6
53 32N 06W	1	2.6	3.1	1	0.4	1
54 32N 06W	1	2.6	3.1	1	0.4	1
63 32N 06W	1	2.6	3.1	1	0.4	1
64 32N 06W	0	0.0	0.0	0	0.0	0
04 32N 05W	8	21.1	25.0	23	9.6	240
05 32N 05W	13	34.2	40.6	35	14.6	592
06 32N 05W	1	2.6	3.1	1	0.4	1
07 32N 05W	0	0.0	0.0	0	0.0	0
08 32N 05W	1	2.6	3.1	1	0.4	1
09 32N 05W	6	15.8	18.8	6	2.5	47
10 32N 05W	6	15.8	18.8	22	9.2	172
11 32N 05W	3	7.9	9.4	4	1.7	16
12 32N 05W	3	7.9	9.4	5	2.1	20
13 32N 05W	5	13.2	15.6	8	3.3	52
14 32N 05W	3	7.9	9.4	6	2.5	23
15 32N 05W	10	26.3	31.3	22	9.2	286
16 32N 05W	9	23.7	28.1	27	11.3	316
17 32N 05W	3	7.9	9.4	6	2.5	23
18 32N 05W	0	0.0	0.0	0	0.0	0
19 32N 05W	3	7.9	9.4	3	1.3	12
20 32N 05W	5	13.2	15.6	8	3.3	52
21 32N 05W	3	7.9	9.4	17	7.1	66
22 32N 05W	1	2.6	3.1	1	0.4	1
15 32N 04W	0	0.0	0.0	0	0.0	0
16 32N 04W	0	0.0	0.0	0	0.0	0
17 32N 04W	9	23.7	28.1	41	17.1	480
18 32N 04W	1	2.6	3.1	1	0.4	1
19 32N 04W	0	0.0	0.0	0	0.0	0
20 32N 04W	0	0.0	0.0	0	0.0	0
21 32N 04W	0	0.0	0.0	0	0.0	0
22 32N 04W	0	0.0	0.0	0	0.0	0
TOTALS				240	100.0	

BANCOS NO. OF SECTIONS = 35 NO. DAYS(LOCAL) = 18

	NO. OF DAYS	% ALL DAYS	% LOCAL DAYS	NO. SIGHTINGS	% SIGHTINGS	PRODUCT OF 4*6
08 32N 06W	0	0.0	0.0	0	0.0	0
09 32N 06W	1	2.6	5.6	1	0.5	3
10 32N 06W	4	10.3	22.2	5	2.5	56
11 32N 06W	3	7.7	16.7	4	2.0	34
12 32N 06W	2	5.1	11.1	4	2.0	23
13 32N 06W	4	10.3	22.2	11	5.6	124
14 32N 06W	0	0.0	0.0	0	0.0	0
15 32N 06W	5	12.8	27.8	9	4.6	127
16 32N 06W	1	2.6	5.6	1	0.5	3
17 32N 06W	0	0.0	0.0	0	0.0	0
20 32N 06W	0	0.0	0.0	0	0.0	0
21 32N 06W	5	12.8	27.8	7	3.6	99
22 32N 06W	2	5.1	11.1	3	1.5	17
23 32N 06W	7	17.9	38.9	20	10.2	395
24 32N 06W	0	0.0	0.0	0	0.0	0
25 32N 06W	2	5.1	11.1	4	2.0	23
26 32N 06W	2	5.1	11.1	8	4.1	45
27 32N 06W	6	15.4	33.3	9	4.6	152
28 32N 06W	3	7.7	16.7	6	3.0	51
33 32N 06W	3	7.7	16.7	5	2.5	42
34 32N 06W	4	10.3	22.2	7	3.6	79
35 32N 06W	8	20.5	44.4	24	12.2	541
36 32N 06W	1	2.6	5.6	2	1.0	6
01 31N 06W	3	7.7	16.7	7	3.6	59
02 31N 06W	3	7.7	16.7	13	6.6	110
03 31N 06W	6	15.4	33.3	17	8.6	288
04 31N 06W	2	5.1	11.1	4	2.0	23
09 31N 06W	0	0.0	0.0	0	0.0	0
10 31N 06W	8	20.5	44.4	22	11.2	496
11 31N 06W	1	2.6	5.6	1	0.5	3
12 31N 06W	0	0.0	0.0	0	0.0	0
05 31N 05W	0	0.0	0.0	0	0.0	0
06 31N 05W	0	0.0	0.0	0	0.0	0
07 31N 05W	1	2.6	5.6	3	1.5	8
08 31N 05W	0	0.0	0.0	0	0.0	0
TOTALS				197	100.0	

LA[redacted]A NO. OF SECTIONS = 43 NO. [redacted](LOCAL) = 14

	NO. OF DAYS	% ALL DAYS	% LOCAL DAYS	NO. SIGHTINGS	% SIGHTINGS	PRODUCT OF 4*6
14 31N 06W	0	0.0	0.0	0	0.0	0
15 31N 06W	4	10.5	28.6	9	9.4	268
16 31N 06W	3	7.9	21.4	5	5.2	112
17 31N 06W	3	7.9	21.4	6	6.3	134
18 31N 06W	1	2.6	7.1	4	4.2	30
19 31N 06W	4	10.5	28.6	11	11.5	327
20 31N 06W	3	7.9	21.4	4	4.2	89
21 31N 06W	2	5.3	14.3	5	5.2	74
22 31N 06W	1	2.6	7.1	1	1.0	7
23 31N 06W	0	0.0	0.0	0	0.0	0
29 31N 06W	0	0.0	0.0	0	0.0	0
30 31N 06W	4	10.5	28.6	5	5.2	149
31 31N 06W	0	0.0	0.0	0	0.0	0
03 30N 06W	0	0.0	0.0	0	0.0	0
04 30N 06W	0	0.0	0.0	0	0.0	0
05 30N 06W	0	0.0	0.0	0	0.0	0
06 30N 06W	0	0.0	0.0	0	0.0	0
07 30N 06W	0	0.0	0.0	0	0.0	0
08 30N 06W	1	2.6	7.1	1	1.0	7
09 30N 06W	1	2.6	7.1	2	2.1	15
10 30N 06W	1	2.6	7.1	1	1.0	7
23 31N 07W	0	0.0	0.0	0	0.0	0
24 31N 07W	1	2.6	7.1	1	1.0	7
25 31N 07W	4	10.5	28.6	7	7.3	208
26 31N 07W	1	2.6	7.1	1	1.0	7
27 31N 07W	1	2.6	7.1	1	1.0	7
28 31N 07W	0	0.0	0.0	0	0.0	0
33 31N 07W	1	2.6	7.1	2	2.1	15
34 31N 07W	3	7.9	21.4	7	7.3	156
35 31N 07W	2	5.3	14.3	2	2.1	30
36 31N 07W	4	10.5	28.6	5	5.2	149
02 30N 07W	1	2.6	7.1	1	1.0	7
03 30N 07W	2	5.3	14.3	2	2.1	30
04 30N 07W	0	0.0	0.0	0	0.0	0
09 30N 07W	0	0.0	0.0	0	0.0	0
10 30N 07W	1	2.6	7.1	1	1.0	7
13 30N 07W	0	0.0	0.0	0	0.0	0
14 30N 07W	1	2.6	7.1	1	1.0	7
15 30N 07W	2	5.3	14.3	3	3.1	45
16 30N 07W	7	18.4	50.0	8	8.3	417
21 30N 07W	0	0.0	0.0	0	0.0	0
22 30N 07W	0	0.0	0.0	0	0.0	0
23 30N 07W	0	0.0	0.0	0	0.0	0
TOTALS				96	100.0	

PINE NO. OF SECTIONS = 35 NO. DAYS(LOCAL) = 15

	NO. OF DAYS	% ALL DAYS	% LOCAL DAYS	NO. SIGHTINGS	% SIGHTINGS	PRODUCT OF 4*6
17 32N 07W	0	0.0	0.0	0	0.0	0
18 32N 07W	0	0.0	0.0	0	0.0	0
19 32N 07W	0	0.0	0.0	0	0.0	0
20 32N 07W	0	0.0	0.0	0	0.0	0
29 32N 07W	1	2.6	6.7	1	0.7	5
30 32N 07W	0	0.0	0.0	0	0.0	0
31 32N 07W	5	12.8	33.3	18	13.4	448
32 32N 07W	3	7.7	20.0	8	6.0	119
05 31N 07W	0	0.0	0.0	0	0.0	0
06 31N 07W	5	12.8	33.3	15	11.2	373
07 31N 07W	3	7.7	20.0	14	10.4	209
17 31N 07W	0	0.0	0.0	0	0.0	0
18 31N 07W	5	12.8	33.3	13	9.7	323
19 31N 07W	2	5.1	13.3	2	1.5	20
20 31N 07W	2	5.1	13.3	2	1.5	20
29 31N 07W	0	0.0	0.0	0	0.0	0
30 31N 07W	2	5.1	13.3	4	3.0	40
31 31N 07W	2	5.1	13.3	3	2.2	30
32 31N 07W	1	2.6	6.7	1	0.7	5
05 30N 07W	0	0.0	0.0	0	0.0	0
06 30N 07W	5	12.8	33.3	6	4.5	149
07 30N 07W	3	7.7	20.0	3	2.2	45
08 30N 07W	2	5.1	13.3	2	1.5	20
17 30N 07W	3	7.7	20.0	5	3.7	75
18 30N 07W	0	0.0	0.0	0	0.0	0
19 30N 07W	1	2.6	6.7	1	0.7	5
20 30N 07W	1	2.6	6.7	4	3.0	20
01 31N 08W	1	2.6	6.7	21	15.7	104
02 31N 08W	1	2.6	6.7	3	2.2	15
03 31N 08W	1	2.6	6.7	1	0.7	5
26 32N 08W	0	0.0	0.0	0	0.0	0
35 32N 08W	0	0.0	0.0	0	0.0	0
36 32N 08W	0	0.0	0.0	0	0.0	0
15 30N 08W	1	2.6	6.7	4	3.0	20
1 N 08W	3	7.7		3	2.2	45
TOTALS				134	100.0	

APPENDIX IV

Winter bald eagle foraging activity and related observations at Navajo Lake, 1979. (A = Adult, I = Immature, U = Unknown, G = Golden Eagle)

Date	Time	Location	Activity
1/9	1215	Piedra Valley	1A perched 10 ft from deer carcass
	1345	Piedra Valley	2A 1I perched 250 yds from another deer carcass
1/10	1330	Piedra Valley	1I soaring vicinity of deer carcass
	1400	near Ignacio	1A perched 30 yds from road and road-kill rabbit
1/11	0750	Piedra Valley	1I flushed from near elk carcass
	1245	San Juan Arm	1A stooped to water, picked up something, possibly a fish
	1300	San Juan Arm	2A 6I flew from rocks and trees around deer carcass at water's edge
1/12	1100	E shore near dam	1A 2I 1U perched near 200-300 waterfowl offshore
1/13	0730	San Juan Arm, N end	1I perched near large flock of waterfowl
	0830	Piedra Valley	1A 2I perched near shoreline carcass
	0900	Piedra Valley	1I perched and tearing food item, a dark bird, possibly raven
	1000	San Juan Arm, N end	1I circled ducks and stooped twice, unsuccessfully
	1030	San Juan Valley	1A perched near snow covered carcass
1/15	1100	Piedra Valley	1I flew from deer carcass with about 50 ravens
	1430	Piedra Valley	1I feeding on something in talons while perched (different area)
	1510	same location	3I 2 feeding on carcass, 1 perched nearby
1/17	0800	San Juan Arm, N end	3A 4I in vicinity of 1, maybe 2, carcasses while about 200 mergansers offshore
1/18	0920	Piedra Valley	1A 2I feeding on deer carcass, 1I perched nearby
	1000	Piedra Valley	1I feeding on deer carcass
	1400	Piedra Valley	1I perched near another carcass
1/19	1410	Piedra Valley	2I on deer carcass
	1715	Piedra Valley	3A 5I 1U apparent feeding on ground below staging area trees
1/22	1420	San Juan Valley	2I perched near deer carcass, 5-8 ravens present
	1445	San Juan Arm, N end	2A perched on ice where 150 ducks offshore

Date	Time	Location	Activity
1/23	1020	San Juan Arm, E shore	1A perched near large group of waterfowl
	1025	San Juan Arm, E shore	2A 1I perched near about 40 pintails
	1320	San Juan Arm, W shore	2A 1I perched near offshore waterfowl
	1345	San Juan Arm, W shore	1A 1I perched near offshore waterfowl
1/24	1300	San Juan Arm, W shore	3A 1I on deer carcass with 3 ravens
1/26	1000	San Juan Arm, N end	1A flew over water and stooped, no waterfowl in area, fishing?
	1030	San Juan Arm, N end	1I flew low over water and hit surface, fishing?
	1150	San Juan Arm, N end	1A flew over water, stooped, hit surface with talons, still no waterfowl, fishing?
	1150	San Juan arm, W shore	1A circling low over terrain and out over waterfowl offshore
1/27	1620	San Juan Valley	1A 2I flushed off new carcass 4A 11I total observed in vicinity
1/28	0900	Piedra Valley	1A 1I flying, soaring over carcass
	1000	Piedra Valley	3U soaring near same carcass
	1015	Piedra Valley	1I flew from carcass
	1333	San Juan Valley	1I 1U on deer carcass
	1345	San Juan Valley	2A 1I perched near same carcass
	1410	San Juan Arm, N end	1I perched on ice near offshore waterfowl
	1415	San Juan Arm, W shore	2A in flight over water, 1 struck surface unsuccessfully, nearest observed waterfowl about 10 yds away, fishing?
	1602	San Juan Arm, W shore	2A same adults remained perched near offshore waterfowl
1/30	1040	San Juan Valley	1I perched near carcass
	1525	San Juan Valley	1A 2I 1G soaring above probable carcass
	1537	San Juan Valley	2I perched near different carcass
	1634	San Juan Valley	1A flew into this carcass and fed, a raven following same approach pattern came in after A left
1/31	1712	San Juan Valley	1I perched near carcass
2/1	1330	San Juan Valley	2I flew from trees near carcass
2/2	1005	San Juan Arm, W shore	1I perched on ice within 60 yds of offshore waterfowl
2/5	1030	Piedra Valley	2I on or near road-killed rabbit, along with several ravens

Date	Time	Location	Activity
2/6	1455	San Juan Arm, W shore	1A 3I feeding on carcass on shoreline
2/8	1100	Pine Arm	1A 1I separate stoops on water as if for fish, both unsuccessful
2/14	1315	near Ignacio	1A standing on carcass, possibly cow, feeding with about 4 ravens
2/15	0930	near Ignacio	2A 1 standing on top of same carcass, 1 perched nearby
	1300	Pine Arm, E shore	1A 1I flew from carcass at water's edge
2/20	1617	San Juan Arm, W shore	3I feeding on carcass on ice
	1700	San Juan Arm, W shore	1A 1U feeding on another carcass onshore
2/28	1130	Pine Arm, E shore	1A 4I feeding on carcass on ice, 1I soaring nearby, opposite shore
	1140	San Juan Valley	3A feeding on carcass on ice
3/6	1010	San Juan Arm, E shore	1A 1I perched near cow carcass where coyote feeding
3/13	1008	San Juan Arm, W shore	1A 2I 1 feeding on deer carcass, A perched nearby
3/27	1107	San Juan Arm, E shore	1A 1I perched on shore feeding, flushed, I dropped fish

APPENDIX V

A list of waterfowl and small mammals potentially occurring in the Navajo Lake area (from RUN WILD - Wildlife Habitat Information Storage and Retrieval System, Patton, 1978).

Common Name	Scientific Name
Waterfowl	
American wigeon	Anas americana
bufflehead	Bucephala albeola
canvasback	Aythya valisheria
cinnamon teal	Anas cyanoptera
common goldeneye	Bucephala clangula
common merganser	Mergus merganser
gadwall	Anas strepera
green-winged teal	Anas crecca
lesser scaup	Aythya affinis
mallard	Anas platyrhrynchos
Northern shoveler	Anas clypeata
pintail	Anas acuta
Canada goose	Branta canadensis
whistling swan	Olor columbianus
redhead	Aythya americana
ring-necked duck	Aythya collaris
ruddy duck	Qxyura jamaicensis
eared grebe	Podiceps nigricollis
horned grebe	Podiceps auritus
pied-billed grebe	Podilymbus podiceps
American coot	Fulica americana
double-crested cormorant	Phalacrocorax auritus
blue-winged teal	Anas discors
Mexican duck	Anas diazi
Small Mammals	
beaver	Castor canadensis
Colorado chipmunk	Eutamias quadrivittatus
least chipmunk	Eutamias minimus
muskrat	Ondatra zibethicus
black-tailed jackrabbit	Lepus californicus
desert cottontail	Sylvilagus audubonii
Nuttall's cottontail	Sylvilagus nuttallii
bushy-tailed woodrat	Neotoma cinerea
Mexican woodrat	Neotoma mexicana
Stephens woodrat	Neotoma stephensi
white-throated woodrat	Neotoma albigual
Abert squirrel	Sciurus aberti
golden mantled ground squirrel	Spermophilus lateralis
rock squirrel	Spermophilus variegatus
Gunnison's prairie dog	Cynomys gunnisoni
long-tailed weasel	Mustela frenata

CHAMA RIVER

WINTERING BALD EAGLE HABITAT AND ECOLOGY ON THE SANTA FE NATIONAL FOREST, NEW MEXICO

PREPARED FOR

U.S. FOREST SERVICE

SANTA FE NATIONAL FOREST

SANTA FE, NEW MEXICO

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15-APRIL-1979

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INTRODUCTION

The bald eagle (Haliaeetus leucocephalus) is now considered an endangered species in most of the contiguous 48 United States, including New Mexico. In New Mexico the bald eagles' status is that predominately of a migrant and winter resident, as no active nest sites are known in the state at present (Ligon 1961, Hubbard 1978). The total wintering population in the state was estimated at 200-300 eagles in 1974-75 by Hubbard (1978). In general, the bald eagle is closely tied to water in both its breeding and wintering habitat. In New Mexico, and more specifically, the Santa Fe National Forest in the northcentral part of the state this also appears to be the case. Wintering bald eagles occur mainly along the Rio Grande and Rio Chama drainages. These areas were studied for the second consecutive winter and this report represents a summary of the findings.

GOALS OF THE STUDY

Several factors are cited for the decline in bald eagle populations in recent years, of which environmental contamination by organochlorine pesticides and habitat destruction appear to be most significant. Hopefully with the ban on use of the persistent pesticides this factor will eventually be of less importance though increasing contamination by polychlorinated biphenyls may pose a similar threat to eagles.

A much more chronic factor which has affected bald eagle populations is destruction or degradation of habitat. Although the largest portion of the habitat loss has occurred within breeding areas, habitat loss has and is presently occurring within wintering areas as well. It is the primary purpose of this study to identify and delineate important habitat parameters of wintering bald eagles on the Santa Fe National Forest (SFNF) so these areas can be protected and managed as to enhance them for eagles.

Other important goals of the study were to determine population numbers and distribution, identify and document disturbance factors, propose management recommendations and conduct research on life history aspects of bald eagles on the SFNF.

HISTORICAL ACCOUNTS

Relatively little is known about New Mexico's wintering bald eagles and historical accounts are hard to come by. Carl Cooper, proprietor of El Vado Ranch on the upper Rio Chama, proved to be a goldmine of information. According to Mr. Cooper bald eagles have wintered along the Rio Chama in most of the 20 years that he has been there, though he has noted a marked decline in numbers over the years. El Vado Lake and the Rio Chama below the lake often support 15-20 eagles depending on surface conditions of the lake (frozen or unfrozen). A high of about 75 eagles (some possibly golden eagles) was noted one year when El Vado Lake and the Rio Chama were drained for repairs and eagles lined the banks feeding on dead or dying fish. Mr. Cooper stated that bald eagles usually arrive in mid-late November and stay until March, depending on weather conditions. Bald eagle sightings are made quite frequently in Chama Canyon during the summer and may indicate the presence of a small year-round resident population.

Historical information was much more limited for the Rio Grande study area. One common report is that large numbers of bald eagles in the area is a fairly recent development. This phenomenon has been noted elsewhere in New Mexico and it is felt that wintering habitat is indeed being created or enhanced by the construction of dams along the major drainages (Ligon 1961, Hubbard 1978). It appears that the recent completion of Cochiti Dam and the impounding of Rio Grande waters behind it have created an attractive aquatic habitat and abundant food source for eagles and consequently use in the area is increasing dramatically. Residents of the Pueblo de Cochiti report that

a "few" bald eagles have always been seen along the Rio Grande during the winter and were usually seen perched in cottonwoods along the Rio below the present day dam.

REVIEW OF 1978 STUDY

A study with goals similar to this one was conducted last winter (1978) by personnel from the Rocky Mountain Forest and Range Experimental Station. An estimated population of 10-15 bald eagles were felt to be utilizing the SFNF portion of the Rio Chama. This population appeared to be highly mobile depending on weather conditions and prey availability (related to silting of the Rio Chama). This area was considered to be the most important wintering area on the forest. No disturbance factors or roosting areas were identified. Six trees were found to be utilized for perching and fish appeared to be the major constituent of the eagle diet.

An estimated population of only 5-10 bald eagles were present along the Rio Grande portion of the SFNF last winter while researchers were in the area, and only three sightings were made. An aerial survey by the New Mexico Department of Game and Fish turned up 14 bald eagles (4 adults, 10 immatures). No specific habitat usage, disturbance factors or recommendations (outside of the need for additional research) were identified.

A third wintering bald eagle population was surveyed last winter; a small, highly mobile population utilizing the north part of the Cuba Ranger District. This scattered population appears to be dependent on a carrion and small mammal prey base. Due to the relatively small, widely dispersed numbers of eagles and deep snows hindering access, little time was spent in the area last winter and none this winter.

STUDY AREAS

As already mentioned, two areas were intensively surveyed this winter, these being the portions of the Rio Grande and Rio Chama found on or near

the SFNF, New Mexico.

RIO GRANDE STUDY AREA

The study area encompassing the Rio Grande stretches from Otowi Bridge on Highway 4 at the north, to a point some four miles (6.4 KM) southwest of Cochiti Dam, a total distance of approximately 26 miles (42 KM). Figure 1 shows the study area which is located roughly 15-20 miles (24-32 KM) west of the city of Santa Fe. The predominate land feature of the study area is White Rock Canyon, a steep to verticle walled canyon up to 1000 feet (305 M) in depth (Figure 2). The elevation at the Rio Grande varies from 5500 feet (1677 M) at Otowi Bridge to 5200 feet (1586 M) below Cochiti Dam. Land ownership and administration varies throughout the study area with SFNF, National Monument, Indian and private lands present (Figure 1). Cochiti Dam and the lake impounded serve a flood control function and are administered by the U.S. Army Corps of Engineers. The lake has a permanent pool volume of 50,000 acre feet and a flood storage capacity of 620,000 acre feet. The Rio Grande froze over twice this winter while Cochiti Lake was frozen over for more than half the study period.

The Rio Grande study area is located within the Great Basin Conifer Woodland biotic community (Brown et al. 1978), and is characterized by scattered pinyon (Pinus edulis) and juniper (Juniperus scopulorum and J. monosperma). The side slopes are generally steep and quite xeric. Within the side canyons running north and west from White Rock Canyon, Ponderosa pine (Pinus ponderosa)occurs in varying densities. Only at Otowi Bridge and below Cochiti Dam do narrowleaf cottonwood (Populus angustifolia) and scattered willow (Salix spp.) occur along the Rio Grande.

Other raptor species noted in the study area besides bald eagles include: red-tailed hawk, marsh hawk, prairie falcon, kestrel, golden eagle and great-

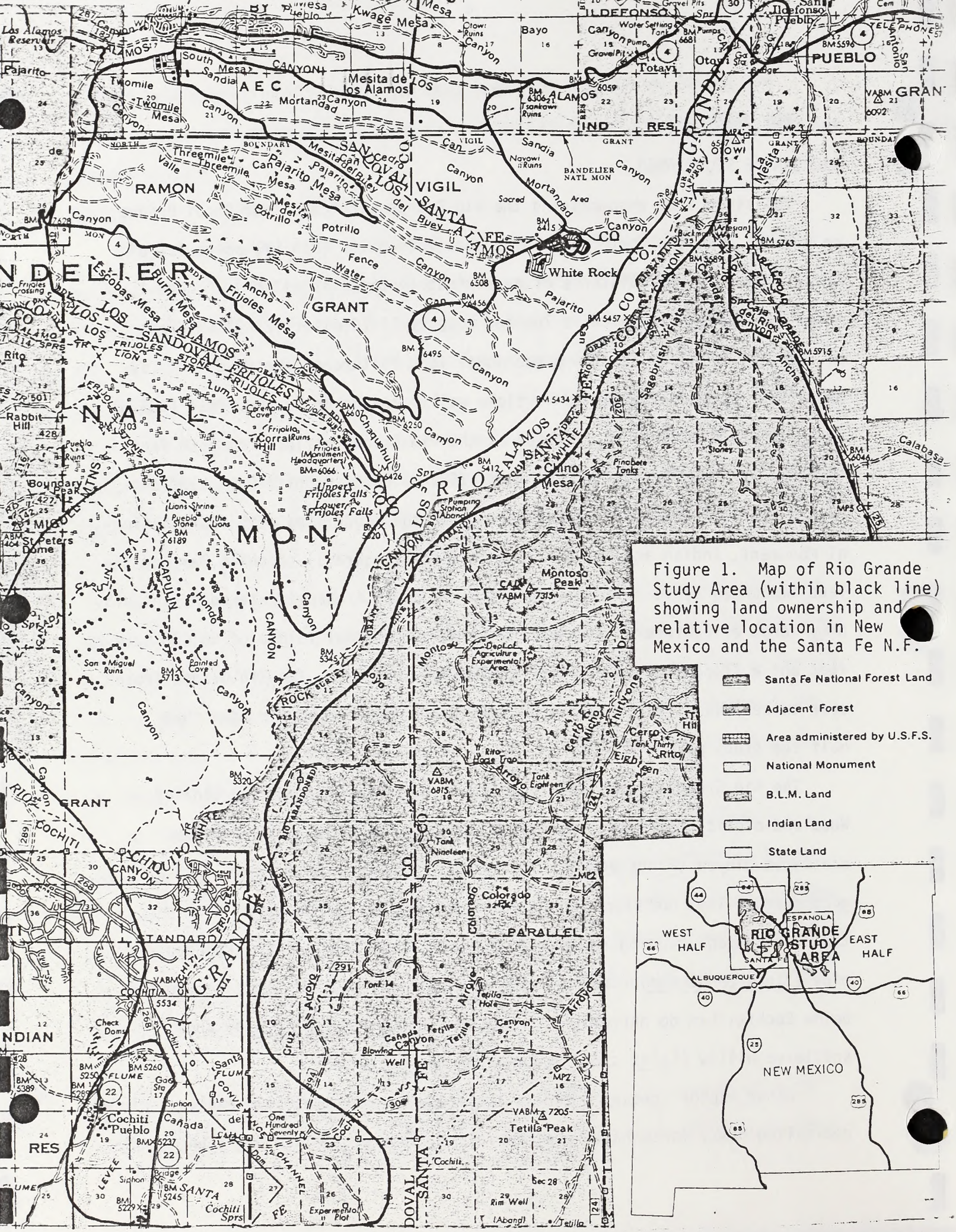

Figure 1. Map of Rio Grande Study Area (within black line) showing land ownership and relative location in New Mexico and the Santa Fe N.F.

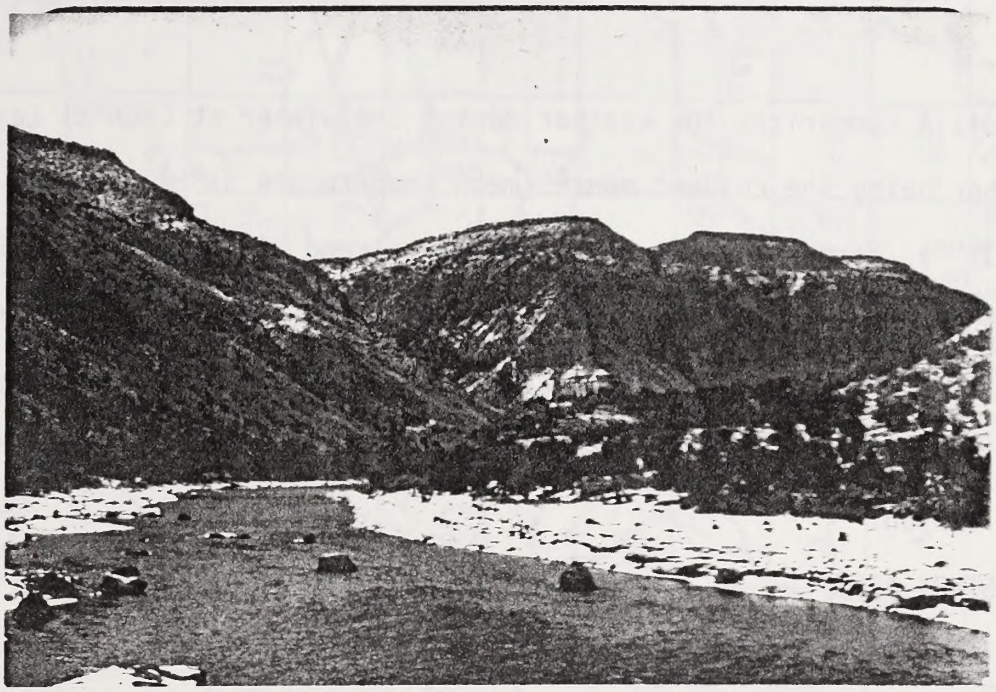

Figure 2. View of White Rock Canyon in the Rio Grande study area looking north towards Frijoles Canyon. Photo taken on 6-January-1979.

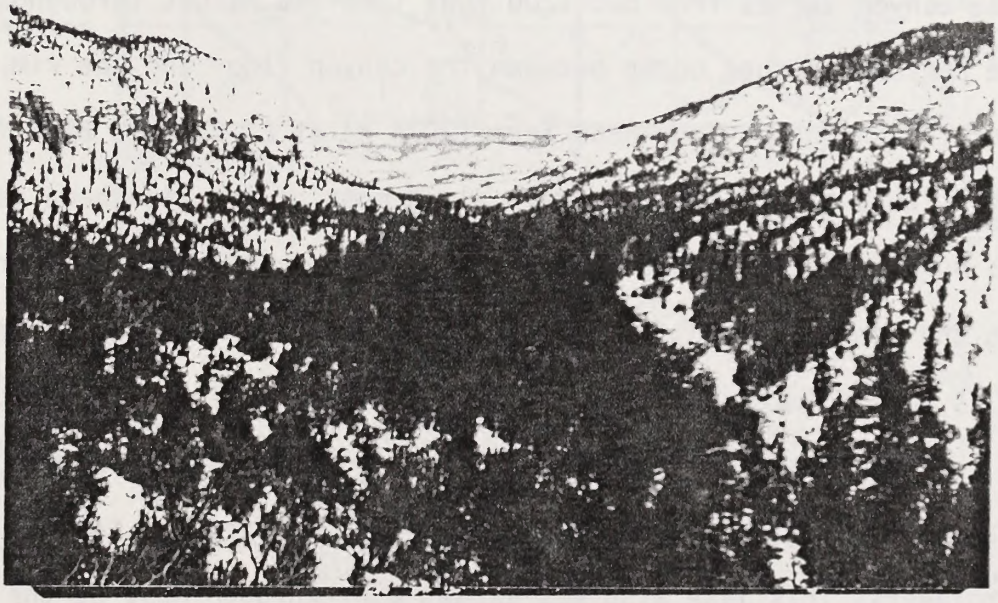

Figure 4. View of the Rio Chama study area, here showing Chama Canyon, looking south from the vicinity of Huckaby Canyon. Photo taken on 5-February-1979.

horned owl.

Appendix A summarizes the weather during the winter at Cochiti Lake, with December being the coldest month (mean temperature 31°F) followed by February (37°F). March showed a marked warming trend with a mean temperature of 46°F. Extremes for the winter were -14° and 68°F., and the winter was generally considered colder than usual. Snow occurred on several occasions but accumulations were light with the exception of the side canyons of White Rock Canyon.

RIO CHAMA STUDY AREA

The Rio Chama study area consisted of that portion of the river from El Vado Dam south to Abiquiu Lake, a distance of about 30 miles (48 KM), and is approximately 60 miles (97 KM) northwest of Santa Fe. The portion of the Rio Chama studied flows through Chama Canyon and the Chama Wilderness Area. Chama Canyon is an impressive, steep walled canyon with verticle sandstone cliffs which rise over 200 feet (61 M) in places (Figure 4). The overall depth of the canyon varies from 800-1200 feet (244-366 M) but throughout much of the canyon, benches occur between the canyon floor and the rim. The elevation of the Rio drops from 6800 feet (2074 M) at El Vado to 6200 feet (1891 M) at Abiquiu Lake. Land ownership along most of the Rio Chama is SFNF though U.S. Bureau of Land Management, state and private lands are found adjacent to the Rio (Figure 3). El Vado Lake was frozen over the entire study period and is administered by the U.S. Bureau of Reclamation. Abiquiu Lake is a flood control reservoir and has a maximum flood storage capacity of 1,374,600 acre feet. This lake and the dam are administered by the U.S. Army Corps of Engineers. This lake also was frozen over through most of the winter and no bald eagle use was noted.

The Rio Chama study area is dominated by the Great Basin Conifer Wood-

Figure 3. Map of Rio Chama Study Area (within dark line) showing land ownership and relative location in New Mexico and the Santa Fe N.F. El Vado and Abiquiu Lakes do not appear on map.

land and intergrades into the Petran Montane Conifer Forest biotic community (Brown et al. 1978). Pinyon and juniper predominate throughout the canyon and side slopes while Ponderosa pine is scattered throughout the canyon bottoms and forms dense stands on the more mesic sites. Douglas fir (Pseudotsuga menziesii) is also scattered about and is more abundant on moister sites. The side canyons, benches and mesa tops are quite heavily timbered with Ponderosa pine and Douglas fir. Along the flood plain, sapling willows abound and south of the confluence of the Rio Chama and Rio Gallina, narrowleaf cottonwoods line the Chama. Gambel oak (Quercus gambelii) is abundant amongst the junipers on the higher banks near the Rio.

Raptor species noted in the study area, in addition to bald eagles include: red-tailed hawk, marsh hawk, Cooper's hawk, merlin, kestrel, prairie falcon, golden eagle, pygmy owl, screech owl and great-horned owl.

The weather at the Rio Chama study area, like that at the Rio Grande, was considered more severe than most winters and was a good deal colder than that of the Rio Grande, averaging 10-20°F cooler (Appendix A). The coldest months were December and January, both with mean temperatures of 19°F. Lows during these months as well as February were consistently subzero. The warmest month was March with a mean temperature of 32°F. Extremes recorded at El Vado were -31° and 55°F. Snowfall accumulations also were above normal and up to two to four feet of snow remained on the ground at the northern part of the study area until March while further south accumulations were lighter. Due to the severe temperatures, the Rio Chama was frozen over through most of the study period with the exception of a three or four mile stretch below El Vado Dam kept open by water releases.

METHODS

The study was initiated on 2-January-1979 and continued until 28-March-1979. During this period, well over 600 hours of field observation were

compiled. The majority of field observation was done while backpacking in the study areas as access by road was limited. Observations were aided by the use of 10X35 binoculars and a 40X spotting scope.

Censusing of the bald eagle populations was done in quite different manners at each study area. At the Rio Grande study area eagles were best censused by counting them as they departed the roosts in the early morning or returned in the late afternoon. This worked best when two observers were stationed at different vantage points. Along the Rio Grande, distinctive birds (e.g. an immature missing 4-6 flight feathers on one wing, subadults with some brown streaking on white head, immatures with white tails with dark terminal bands, etc.) were observed frequently and their presence facilitated determining habitat usage and movements. At the Rio Chama study area censusing was more difficult as the population was more dispersed and utilized several roosting sites quite far apart. Censusing was therefore done while backpacking or hiking as well as observing the roost sites. Birds in the El Vado area were easier to observe as they congregated in a small area along the Chama. Systematic bald eagle aerial surveys were conducted for the second consecutive year by the New Mexico Department of Game and Fish and were extremely valuable in helping to ascertain eagle numbers and distribution. Three flights were made this winter (one by the SFNF) and two last winter, the results summarized in Table 1. Age ratios of bald eagles in the areas were determined by aging eagles according to Southern (1964) and Servheen (1975). Eagles aged six years and over were classed as adults while those one to five were considered immatures (referred to as subadults by Servheen).

Food habits, behavior and diurnal movements of bald eagles in the study areas were determined from direct observation, when possible. This was best done at Cochiti Lake where large numbers of eagles, foraging and behavior

Table 1. Results of fixed wing aerial surveys, 1978-79. All flights except 28-Mar-1979 conducted by New Mexico Department of Game & Fish.

	No. Bald Eagles Observed	
Flight Date	Rio Grande Study Area	Rio Chama Study Area
24-Feb-1978	4 Adult, 10 Immature	Not Flown
15-Mar-1978	Not Flown	2 Adult, 1 Immature
30-Nov-1978	1 Adult, 2 Immature	4 Adult, 1 Immature
23-Jan-1979	4 Adult, 8 Immature	3 Adult, 4 Immature
28-Mar-1979	-0-	1 Immature

could be observed from the shore. Observation in the Rio Chama study area was hindered by relatively low numbers and the high mobility and dispersed nature of the eagles.

Bald eagle perching and roosting trees were measured using a DBH (diameter at breast height) tape and a clinometer to determine height. In addition, live trees were classified using Keen's Ponderosa pine tree classification based on age and vigor (U.S. Forest Service 1975). Several other parameters were recorded for perching and roosting trees such as perch location in the tree, distance to water, stand composition and continuity, tree condition, protection from wind, aspect and slope, etc.

In addition to direct observation, food habits information was obtained by analyzing eagle castings and food remains found under roost and perch trees. Biases are possibly induced when using such indirect methods as these but castings and remains provide an invaluable amount of information concerning eagle food habits. Possible biases include a possible overlap between observations, castings and remains but more significant is the underestimation of fish in the diet due to the fact that fish yield little in the way of remains or castings.

RESULTS AND DISCUSSION

POPULATION DYNAMICS, SEASONAL MOVEMENTS AND DISTRIBUTION

An important aspect of the study was to determine wintering bald eagle population numbers, age structure, dates of arrival and departure and distribution in the study areas.

RIO GRANDE STUDY AREA

Population Dynamics

A peak population of 19 bald eagles was recorded in the Rio Grande study area and was reached sometime between early to mid January (Figure 5). This population was quite static throughout a good portion of the winter

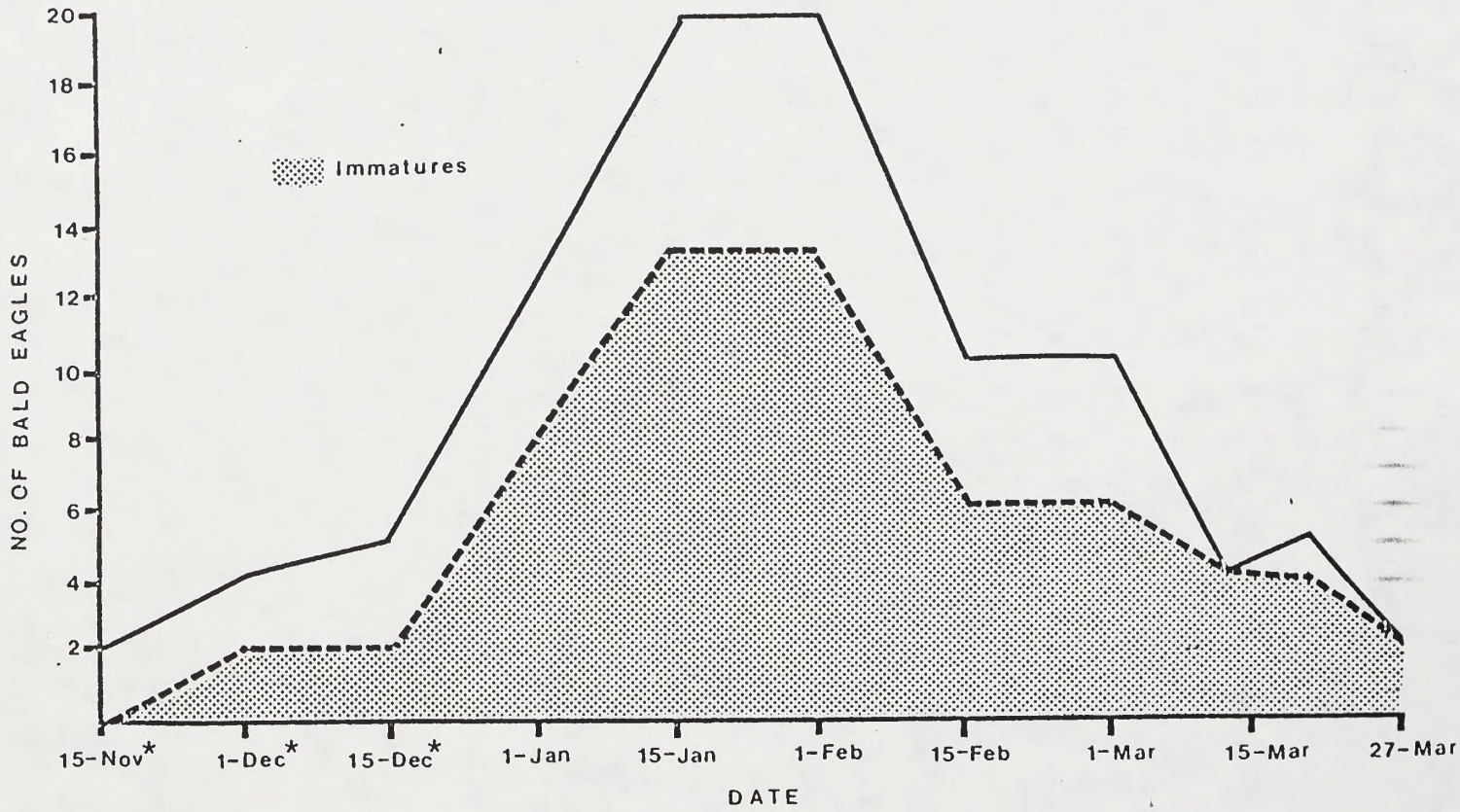

Figure 5. Graph showing seasonal changes and age structure in bald eagle numbers during the winter of 1978-79 at the Rio Grande study area. *=population estimates for these dates provided by T. Johnson or aerial surveys.

with the peak numbers being maintained until early to mid February which agrees favorably with peak dates in other areas (Edwards 1969, Southern 1964, Servheen 1975). The age structure in the area was highly disproportionate towards immatures (Figure 5) with a breakdown of 13 immatures and 6 adults (2.2:1) during the peak. This high percentage of immatures, 68%, is higher than any other reported in the literature, of which the highest was 55% at Glacier Park, Montana (Shea 1973). Wintering populations in northern Arizona were found to be composed of 84% immatures (pers. obs.). Exactly what a "high" proportion of immatures in a population indicates is not readily known. Along the Rio Grande it may very well reflect the fact that the area represents fairly new habitat since the recent impounding of the Rio Grande behind Cochiti Dam. Implied here is that immatures disperse more readily than adults in search of suitable areas and initially form the bulk of the population at newly created or discovered wintering sites. Other possibilities include differences in migratory patterns, habitat selection or responses to other factors between adults and immatures (Servheen 1975). The high ratio of immatures to adults may even indicate that the area represents marginal habitat though this is unlikely. Also unlikely is that the high percentage of immatures is accountable solely by increased reproductive success in breeding populations, as more "typical" ratios were recorded during aerial surveys this winter elsewhere in New Mexico.

Seasonal Movements

Bald eagles first arrived in the Rio Grande study area during the first week of November which coincided with the passing of large flocks of sandhill cranes (Grus canadensis) headed further south and followed a build-up in waterfowl numbers by about two weeks (T Johnson pers. com.). The first two birds seen were adults and the first immature was recorded on 15-November-1978. There was a slow increase in the population until mid December when numbers approached the peak in early January.

In mid February there was a noticeable drop in eagle numbers to 10 birds (Figure 5) which coincided with a general warming trend along with initiation of the northward migration by sandhill cranes and a decline in waterfowl numbers. By mid March the population had declined to four birds and by early April (T. Johnson pers. com.) all eagles had departed from the study area. It appeared that immatures initiated the spring migration though this is by no means conclusive and does not clearly disagree with Southern's (1963) findings where adults left the wintering areas prior to immatures.

Where wintering bald eagles in the southwest U.S. come from is one topic which has yet to be conclusively answered. If one considers where the bulk of non-Alaskan breeding populations are located, Canada and the northern U.S., it is probable that these populations "feed" the southwestern wintering areas. Gerrard (in Snow 1973) reports that returns from eagles banded in Saskatchewan have been made as far south as Texas and Arizona. Migrating eagles gather at Glacier National Park, Montana in early-mid October and depart in late November to early December, apparently heading further south (Shea 1973). This movement coincides somewhat with build-ups in southwestern wintering populations (Edwards 1969, this study). The origin of an adult bald eagle at the Rio Grande study area is known, this bird accounting for the slight increase in adult numbers between mid-late March (Figure 5). This increase was due to the release of an adult at Cochiti Lake on 14-March-1979 by Dr. Phillip Schulz after he helped it recover from poisoning. The eagle was found near Estancia, New Mexico. The eagle remained in the area for approximately 10 days before heading north, and appeared to be in sound health.

Distribution

Bald eagles in the Rio Grande study area utilized the habitat in a fairly consistent manner throughout the winter. Appendix B shows the relative

bald eagle habitat use based on number of observations. Two areas of high use were noted, the area around Cochiti Lake and the side canyons of White Rock Canyon which were utilized heavily for roosting. The high use around Cochiti Lake is related to the availability of prey, a factor which is often felt to govern wintering eagle concentrations in general. Eagles were most abundant at Cochiti Lake when the lake was nearly frozen over. This condition concentrated prey in small openings in the ice and also provided what appeared to be preferred loafing sites for eagles. When the surface of the lake was unfrozen eagle use increased below the dam which is related to the dispersal of the waterfowl prey base and an increase in human disturbance at the lake. A slight increase in use was observed along the Rio Grande above Cochiti Lake when it was unfrozen, but this area's use by eagles was still predominately that of a travel corridor between roosting areas and the lake. Bald eagle use along the Rio Grande north of the northern most boundary of Bandelier National Monument (Frijoles Canyon) remained low throughout the winter. Few sightings were made along this stretch of the Rio with the exception of a lone adult seen in the vicinity of Otowi Bridge on several occasions.

RIO CHAMA STUDY AREA

Population Dynamics

As previously mentioned, the Rio Chama wintering population is a highly mobile and dispersed one and it reached an estimated peak of 15 eagles during a short period in late February (Figure 6). Throughout most of the winter bald eagle numbers fluctuated in response to weather conditions and prey availability. Of the peak population (9 adults, 6 immatures) only 40% of the eagles were immatures and this percentage was fairly constant throughout the winter (Figure 6).

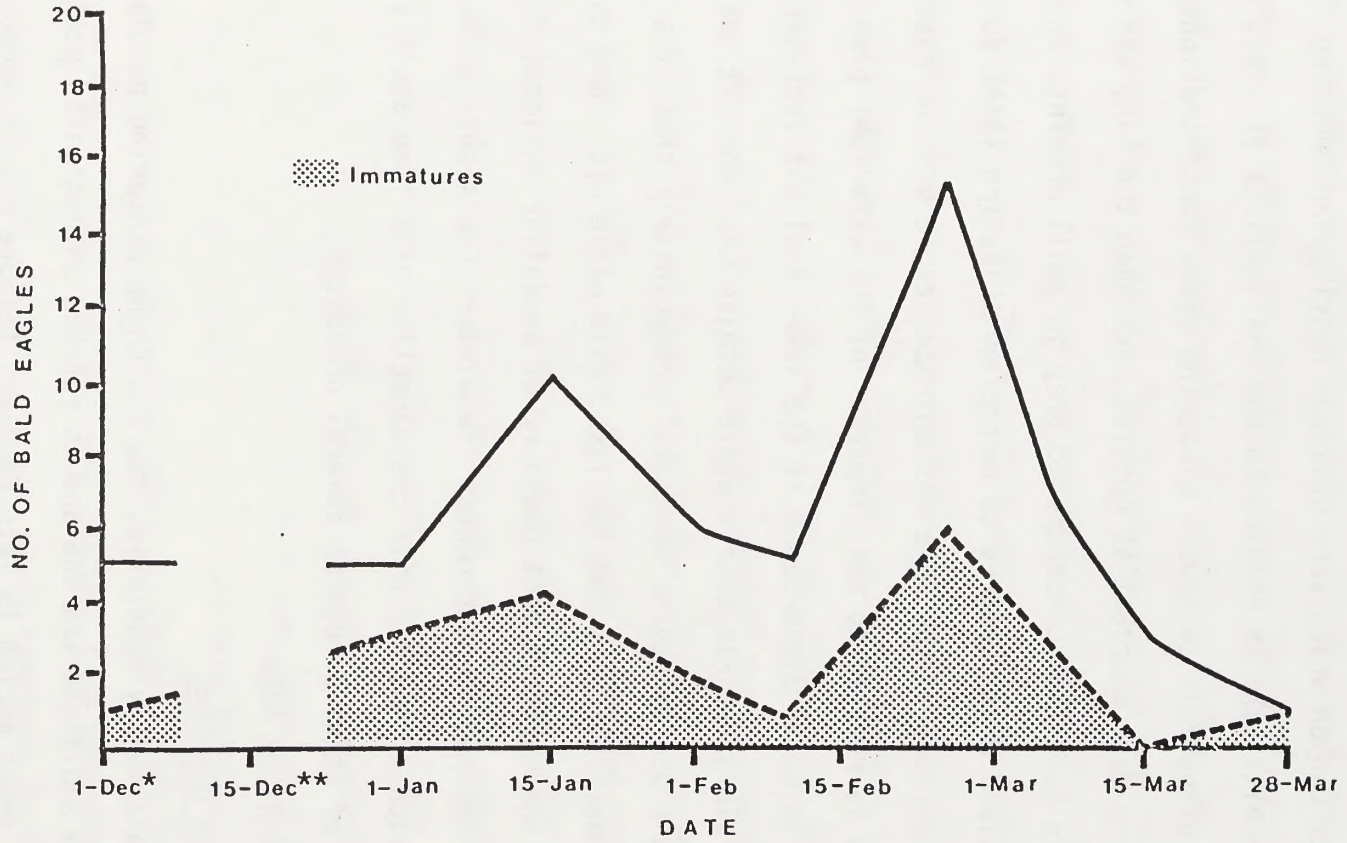

Figure 6. Graph showing seasonal changes and age structure in bald eagle numbers during the winter of 1978-79 at the Rio Chama study area. *=population estimate for this date from aerial survey, **=no population estimate for this date.

Seasonal Movements

The first census of bald eagles in the Rio Chama study area was done during the 30-November-1978 aerial survey (Table 1). At this time four adults and one immature bald eagle were sighted in the area. No other censuses were conducted until early January when a similar five eagles were recorded but there was an increase in the proportion of immatures (Figure 6). A temporary increase in numbers was seen in mid January (to 6 adults, 4 immatures) though few of the birds were within Chama Canyon. They were seen over the mesas adjacent to the canyon, presumably hunting for terrestrial prey as the Rio Chama was frozen over at this time. In late February another large, temporary increase was noted which reached the population peak. This increase was closely related to the breaking up of the ice on the Rio Chama and thus an increase in prey availability. From this time on however, the eagle numbers in the study area declined until the end of March where only one immature was sighted during the aerial flight. During this flight large numbers of eagles were seen at El Vado and Heron Lakes to the north of the study area. Some of the 17 eagles seen here may have been birds which were utilizing Chama Canyon. These lakes appear to be used by eagles as staging areas as they prepare to migrate further north.

Distribution

Appendix C shows the relative bald eagle distribution and relative use in the Rio Chama study area this winter. The highest and most consistently used area was the one located below El Vado Dam. This area was important to eagles for two reasons: 1) the Rio Chama here remained unfrozen due to releases from the dam and 2) the Rio received relatively little silting due to an absence of major tributaries such as the Rio Nutrias and Rio Gallina futher down the river. Another high use area was that in the vicinity of the junction of Huckaby and Chama Canyons (Figure 4). It is not known why eagles preferred

this relatively small stretch of river, though a high availability of hunting and loafing perches, the proximity of the Monastery Roost and the large oxbow along the Rio which might have provided a favorable situation for foraging may be factors. This high use in the area was also noted during the study last winter.

The overall primary determinant of eagle abundance and distribution in the area below El Vado were ice conditions of the Rio Chama. When mostly frozen over, few eagles were generally seen, and those seen were usually out of the canyon. The other factor which appeared to affect eagle distribution was silting up of the Rio Chama. This occurred initially below the confluence of the Rio Gallina where eagle use was relatively light anyway and no change in distribution was detected. But in early March heavy silting occurred in the Chama from below the confluence of the Rio Nutrias and no eagles were observed from this point on downriver. Similar results were found last winter. This silting definitely affects the ability of bald eagles to detect fish in the Rio as turbidity obscured the vision of a crude Seki disc (a white ski pole basket) at only 1.5 inches (3.8 cm) below the surface.

HABITAT COMPONENTS

Habitat components identified during the study include perching/loafing areas, roosting areas and foraging areas. Bald eagles appear quite adaptable in their selection of perching sites and are very opportunistic hunters. The most specific habitat parameter seems to be that of roost site selection and in many areas the same roost(s) have been used for many years.

PERCHING / LOAFING AREAS

In both study areas eagles were observed utilizing trees, cliffs and the ground (including rocks and boulders) for perching or loafing. In addition, at the Rio Grande study area the frozen surface of Cochiti Lake made up an

important perching/loafing substrate. Specific activities often predominated in different trees, ice or cliffs. These specific uses include hunting, loafing and pre-roosting staging.

Rio Grande Study Area

Trees. Four species of trees were utilized by bald eagles along the Rio Grande for perching/loafing; juniper, Ponderosa pine, narrowleaf cottonwood and willow. A total of 35 trees showed bald eagle use (Appendix B) and are summarized in Table 2. The vast majority of the trees were junipers along the northeast shore of Cochiti Lake where eagles congregated throughout much of the winter. These trees made up 68% of the total and of them, more than two thirds were dead and were located in the lake (mean distance to lake 6.3 yards or 5.8 M). Eagles appeared to prefer these dead trees due to easy approach to the upper dead, unfoliated limbs and also the close proximity of the trees to prey concentrations (Figure 7). Most of the trees here appeared to be used mainly for loafing as large inactive amounts of time were spent in the trees. Some of the more heavily used junipers which were located in the lake were often used as hunting perches from which eagles launched an attack (Figure 7). As the level of Cochiti Lake rose, as it will do during floods, "preferred" dead trees will be created. In fact, a long term supply of dead trees will be insured as the permanent pool level will rise every few years as the lake silts in.

All but one of the cottonwood and both willow perch trees are located below Cochiti Dam along the Rio Grande (Appendix B). Most of the trees were used mainly for loafing though one cottonwood was used frequently as a hunting perch. This tree has a large dead limb which protrudes out over the Rio and hunting attempts were frequently made from this limb.

The low number of Ponderosa pine perch trees utilized by bald eagles represents not so much a preference by eagles for other species than it does

Table 2. Bald eagle perching/loafing tree summary for Rio Grande study area.

Tree Species	Total No.	No. Trees in Condition Class*					$\bar{X}$ Ht.	$\bar{X}$ DBH	$\bar{X}$ Distance to Water
		1	2	3	4	5	ft. (M)	in. (cm)	yards (M)
Juniper	23	16	0	0	0	7	5.8 (1.8)	N/A	6.3 (5.8)
Ponderosa Pine	3	1	0	0	0	2	94.0 (28.7)	49.6 (126.0)	50.0 (45.7)
Cottonwood	7	0	0	0	1	6	60.2 (18.4)	48.2 (122.4)	70.3 (64.3)
Willow	2	0	0	0	0	2	18.0 (5.5)	N/A	10.0 (9.1)
Totals or Grand Mean	35	17	0	0	1	17	19.6 (6.0)	48.4 (122.9)	20.2 (18.4)

*Condition Classes: 1 = dead, top intact; 2 = dead, top broken; 3 = live, top broken; 4 = live, top intact but dead; 5 = all live

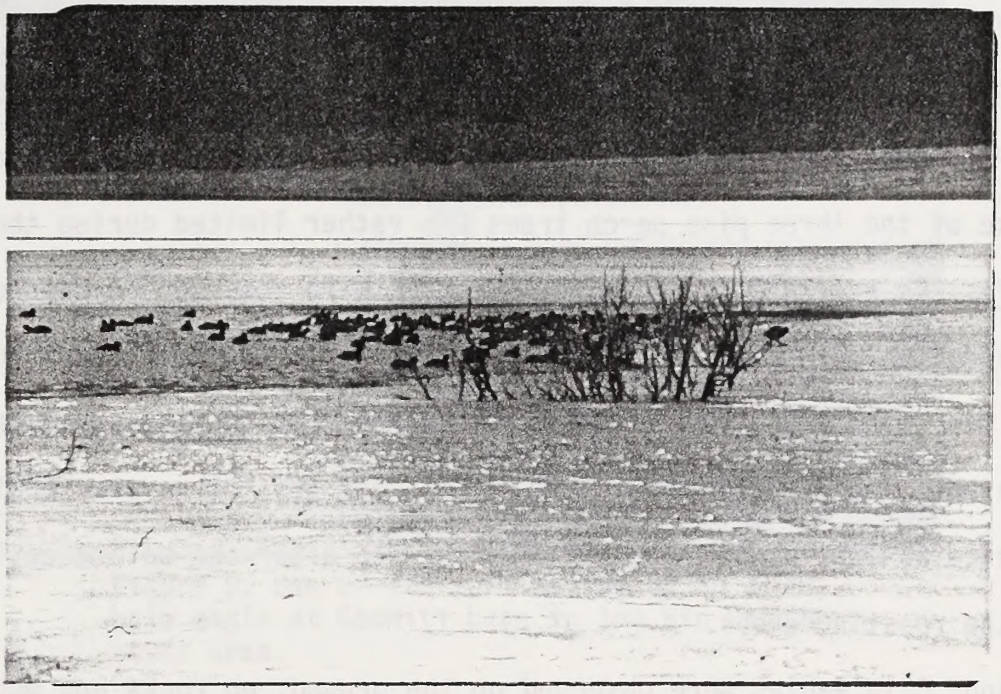

Figure 7. Most heavily used bald eagle perch tree (juniper) at Cochiti Lake in Rio Grande study area. Note close proximity of perch to coot concentration.

Figure 8. Bald eagle perching/loafing cliff near Alamo Canyon in Rio Grande study area. Arrow denotes general location of heavily used perching/loafing site.

a lack of Ponderosa pines outside of the roosting areas. Throughout the entire 26 mile (42 KM) stretch of the Rio Grande in the study area, no more than 20 Ponderosa pine trees are present within 30 yards (27 M) of the river. Use of the three pine perch trees was rather limited during the study.

Cliffs: On several occasions bald eagles were observed perched on a small ledge on a 100-150 foot (31-46 M) high verticle cliff near the mouth of Alamo Canyon, see Appendix B and Figure 8. This cliff has an east exposure and appeared to be utilized as a loafing area and possibly a pre-roosting staging site as most sightings were made in late afternoon before eagles flew to the roosting areas.

Ground: Bald eagles were observed on the ground, on rocks and boulders at several locations throughout the study area. At only two spots, one across from Arroyo Montoso near the Rio Grande and the other at the far east shore of Cochiti Lake were eagles seen more than once. Eagles were often seen on the ground at various spots amongst the juniper perch trees at Cochiti Lake and frequently fed on prey here.

Ice: When frozen over the surface of Cochiti Lake provided the most heavily utilized perching/loafing site in the study area (Figure 9). Up to 14 bald eagles were observed on the ice, often in groups of 5-7. The high use of the ice may be related to two things: 1) it allowed eagles to get closer to prey than trees often did and was used for hunting and 2) appeared to supply the birds with a preferred loafing substrate as the albedo factor was much higher than for trees or the ground, especially on cold days and in the early morning when eagles spent large amounts of time sunning. On some days almost all perching/loafing was done on the ice while little or none was observed in trees. Feeding on prey items which had been caught was most often observed on the ice at Cochiti Lake.

Figure 9. Use of ice for loafing by an adult bald eagle at Cochiti Lake in the Rio Grande study area.

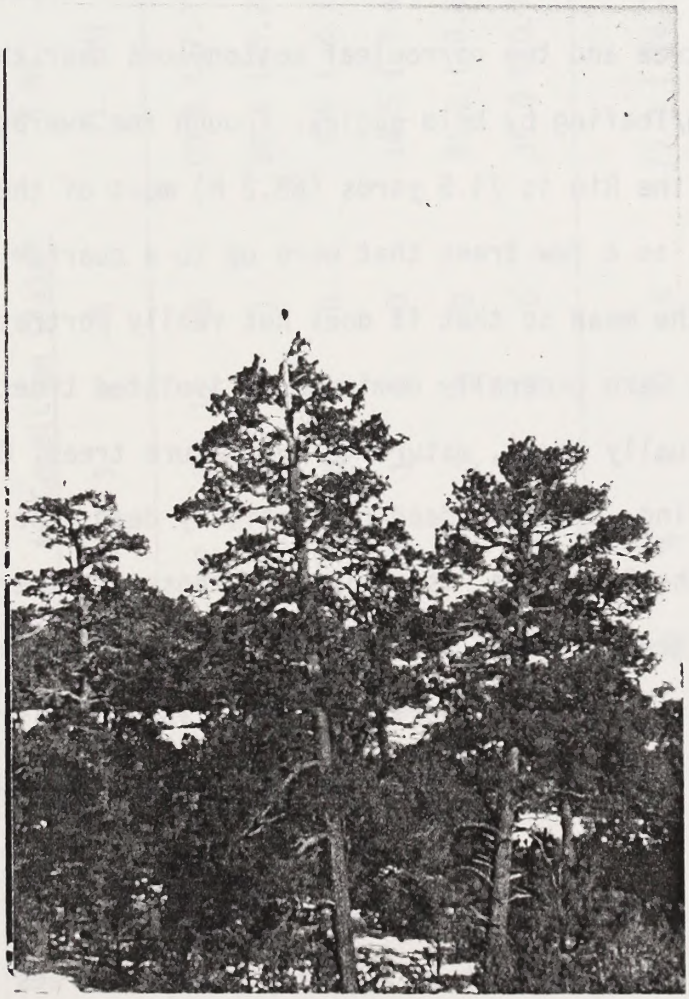

Figure 10. Heavily used spike top Ponderosa pine perch tree with adult bald eagle in the top. Rio Chama study area.

Rio Chama Study Area

Trees: Within the Rio Chama Study area a total of 47 different trees were utilized by bald eagles for perching/loafing, with locations shown in Appendix C. The characteristics of the trees are summarized in Table 3. The most commonly used and preferred trees were Ponderosa pines which made up 66% of the total. Of these trees, 84% were either dead or had at least dead tops. The most preferred Ponderosa perches were snags with intact tops, though a few of more heavily used trees were live with dead "spike" tops (Figure 10). All but one of the Douglas fir perch trees were dead with intact tops. Three dead juniper trees were used as perches by eagles in the study area, all within two miles of El Vado Dam. Four Gambel oak trees showed signs of eagle use and all were either dead or were live with broken tops. Only one ash (Fraxinus spp.) tree and two narrowleaf cottonwoods near the Rio Chama were used for perching/loafing by bald eagles. Though the average distance of all the trees from the Rio is 74.5 yards (68.2 M) most of the trees were typically much closer, as a few trees that were up to a quarter mile from the Rio Chama raised the mean so that it does not really portray the actual situation. Perch trees were generally dominate or isolated trees. Those trees that were live were usually large, mature to overmature trees. Of the trees used for perching/loafing, 87% were dead or partially dead. The preference for dead trees along the Rio Chama is similar to those at other wintering areas (Stalmaster and Newman 1979 , pers. obs.), though some populations show a predilection for live trees (Servheen 1975). The majority of eagles sighted in perch trees were in the top or upper third of the tree (Figures 10 and 12).

Most of the perch trees were used by eagles for loafing as long periods of time were spent in the trees with no activity. Several trees served the purpose of hunting perches and one common characteristic of these trees is

Table 3. Bald eagle perching/loafing tree summary for Rio Chama study area.

Tree Species	Total No.	No. Trees in Condition Class* 1	2	3	4	5	$\bar{X}$ Ht. ft. (M)	$\bar{X}$ DBH in. (cm)	$\bar{X}$ Dist. to Water yards (M)	No. Trees Beaver Girdled
Ponderosa Pine	31	11	2	2	11	5	89.5 (27.3)	30.6 (77.7)	96.6 (88.4)	0
Douglas Fir	6	5	0	0	0	1	82.5 (25.2)	26.5 (67.3)	20.0 (18.3)	4
Juniper	3	3	0	0	0	0	9.0 (2.7)	N/A	86.7 (79.3)	0
Gambel Oak	4	1	2	1	0	0	14.5 (4.4)	12.3 (31.2)	3.5 (3.2)	1
Cottonwood	2	0	0	0	2	0	61.0 (18.6)	45.7 (116.1)	55.0 (50.3)	1
Ash	1	0	0	1	0	0	35.0 (10.7)	not measured	5.0 (4.6)	0
Totals or Grand Mean	47	20	4	4	13	6	73.3 (22.3)	28.9 (73.4)	74.5 (68.2)	6

* Condition Classes: 1 = dead, top intact; 2 = dead, top broken; 3 = live, top broken; 4 = live, top intact but dead; 5 = all live

their close proximity to the Rio Chama. All four of the oak trees were used as hunting perches and all overhang the Rio and provide an excellent view of pools in which fish could be spotted (Figure 11). Several of the perch trees were used predominately as staging sites where eagles would perch in the late afternoon before flying to roosting areas. In general, these trees were Ponderosa pine or juniper and were located high on the side slopes or rim of the canyon and gave eagles their last chance to bask in direct sunlight before the sun set. These trees may also play a social function similar to those described for roosts as "information centers" in passing on prey locations, only in this case they may be used to pass on roost site locations.

A very interesting relationship was noted both this winter and last and is that between beavers (Castor canadensis) and eagle perching/loafing trees. Bald eagles perched in several snags which had been girdled and subsequently killed by beavers. Though beavers show a strong predilection for girdling Douglas fir trees, they have also made their mark on Ponderosa pines, oaks and cottonwoods. Table 3 shows the number of each species of tree which were girdled and used by eagles for perching. Six of the 47 perch trees (13%) were girdled including two thirds of the Douglas fir prech trees (Figure 13). This activity should help insure that there is always an adequate supply of preferred perching trees in Chama Canyon.

Cliffs: One cliff was utilized by eagles for perching/loafing in the Rio Chama study area, this located south of the SFNF boundary 250 yards (229 M) from the Rio Chama. This cliff has a west exposure and is approximately 100 feet (31 M) high. This perching site may be utilized as a hunting post as rabbits are abundant below the cliff in the sparse, invader type vegetation present because of past inundation by Abiquiu Lake.

Ground: Along the Rio Chama the bank and rocks were utilized by eagles for perching. Eagles were occasionally seen along the shore and on rocks

Figure 11. Bald eagle hunting perch (Gambel oak) along Rio Chama. Arrow denotes perch location in the tree.

Figure 12. Use of a broken top perch tree (cottonwood) by immature bald eagle. Tree located along Rio Chama.

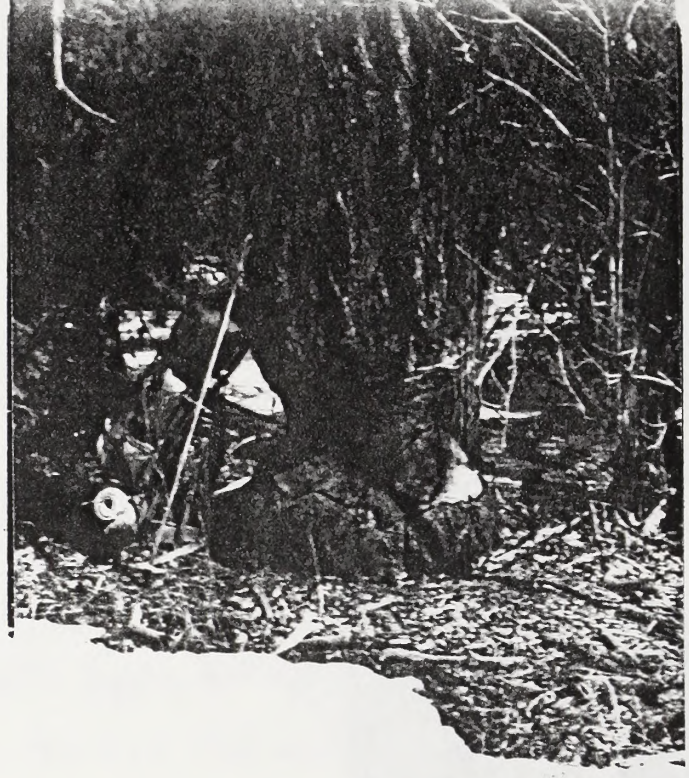

Figure 13. Beaver girdled bald eagle perch tree (Douglas fir) along the Rio Chama. DBH of this tree is 31.3 inches (79.0 cm).

Figure 14. Monastery Roost in Rio Chama study area. Note the large open areas between limbs ("windows") of leaning tree. These provide eagles with easy access to crown to roost.

in the river below El Vado Dam, and appeared to be hunting from these spots. One large boulder along the Rio north of Huckaby Canyon was used quite heavily by eagles for hunting. The bank was often used by eagles feeding on fish and other prey that had been caught.

ROOSTING AREAS

Roosting areas are those sites where bald eagles spend the night, usually communally. These areas are characterized by being located in protected side canyons or bowl-shaped ravines, are often in mature or old-growth timber, provide protection from winds and are trees which possess "windows"- large openings in the canopy which allow eagles access to large, stout limbs (Coffey 1977, Edwards 1969, Swisher 1964, U.S. Forest Service 1977).

Rio Grande Study Area

Six roosting areas were utilized by bald eagles this winter and a seventh showed some evidence of use, possibly from previous winters as none was noted this year (Appendix B). Of the seven only one, the Sanchez Roost, is located on the SFNF. All the others are located in Bandelier National Monument where T. Johnson is conducting a bald eagle study this winter. The emphasis of his study includes habitat parameters, behavior and disturbance factors at the Bandelier roosts and his report should cover these aspects of the Bandelier roosts in more depth than this report. Table 4 summarizes and lists the roost areas used by eagles in the Rio Grande study area.

Sanchez Roost: This is the only roost on the SFNF and it is located up Sanchez Canyon where it runs northwest to southeast and is approximately 3.7 miles (6.0 KM) from the Rio Grande. This roost received low, infrequent use during the winter with eagles observed flying to the area on only two occasions. This is the most heavily timbered roost area and is characterized by dense old growth and overmature Ponderosa pine. Only one tree showed signs of eagle

Table 4. Bald eagle roost tree summary by roosting area for Rio Grande study area.

Roost Area	No. Known Roost Trees	No. Suspected Roost Trees	No. Trees in Condition Class* 1	2	3	4	5	$\bar{X}$ Ht. ft. (M)	$\bar{X}$ DBH in. (cm)	Relative Degree of Use
Alamo Bottoms	3	9	0	0	2	0	10	96.9 (29.5)	39.1 (100.4)	Moderate; Consistent
Mid-Alamo	0	16	11	2	1	0	2	71.3 (21.6)	23.1 (59.2)	Moderate; Sparadic
Capulin	1	1	0	0	0	0	2	85.8 (26.0)	31.4 (80.5)	Low; Consistent
Painted Cave	5	17	5	1	0	1	15	83.5 (25.3)	31.9 (81.8)	Heavy; Consistent
Mid-Capulin	6	17	17	1	0	1	4	100.6 (30.5)	30.7 (78.9)	Heavy; Consistent
Sanchez	0	1	0	0	0	0	1	125.0 (38.1)	30.3 (77.7)	Low; Sparadic
Medio	0	2	2	0	0	0	0	92.1 (27.9)	22.7 (58.1)	No use Observed
Total or Grand Mean	15	62	36	3	2	2	34	89.1 (27.0)	30.7 (78.8)	

* Condition Classes: 1 = dead, top intact; 2 = dead, top broken; 3 = live, top broken; 4 = live, top intact but dead; 5 = all live

use though there are possibly more (Table 4). This tree is a large overmature Ponderosa which lies in the bottom of the canyon. The tree is sheltered by other trees and the narrow nature of the canyon in the vicinity. Why this area did not receive heavier use for roosting is only a matter of speculation. The site is in the bottom of an extensive drainage which originates near 7800 feet (2379 M) in elevation and this, coupled with the narrowness of the canyon at this point may result in a cold air drainage which is intolerable to bald eagles.

Alamo Bottoms Roost: Located near the mouth of Alamo Canyon and extending up canyonfor approximately one mile (1.6 KM), this was the first roost to be utilized by eagles this winter (T. Johnson pers. com.). This area received consistent use from two to three eagles throughout the winter, of which two were usually adults. Here, three trees were known to have been used by eagles for roosting and another nine showed signs of use (Table 4). All are Ponderosa pine of which two are live with broken tops (including the most regularly used tree) and the rest are all live. Of these trees, most are large mature to overmature as classified by Keene's classification. The site is found in the bottom of the canyon (with the exception of one tree on the side slope) which is rather sparsely timbered with Ponderosa. Pinyon, juniper and alder (Alnus spp.) also are prevalent in the roost area. A fair amount of protection is afforded by surrounding trees and the walls of the north to south running canyon. There is some indication that this roost receives less use during periods of extreme cold temperatures.

Mid-Alamo Roost: This roost area is found further up Alamo Canyon approximately 1.5 to 3 miles (2.4-4.8 KM) from the Rio Grande. This roost was utilized somewhat sporadically throughout the winter by three to four bald eagles. Use of the area may have been related to climatic conditions or

human disturbance at other roost areas. No trees were actually observed being used by eagles, however, 16 Ponderosa pine trees showed signs of eagle use as roosts. Of these trees, 13 were snags and only three were live (Table 4). The high percentage of snags in this and other roost areas is somewhat surprising though not unprecidented (Servheen 1975, Spencer 1976). Dead trees may allow for easier access to the upper limbs as well as providing a superior approach and takeoff as these trees are usually isolated. This roost area is typically sparsely timbered and juniper predominates in the area. The canyon is narrow here, running north to south, and affords a fair amount of protection from the predominately westerly winds.

Capulin Roost: This roost area contains only one known roost tree and one other suspected of having been used by bald eagles, both live Ponderosa pines. The known roost tree is a large dominant, overmature one and was used only by two adults consistently all winter. Immature eagles often utilized the tree as a staging site prior to moving further up the canyon to other roosts. Located in Capulin Canyon about 1.4 miles (2.2 KM) from the Rio Grande, the roost is in the lowest extension of Ponderosa pine in the canyon, here forming a sparse stand. The canyon is quite broad here, running northwest to southeast, and the roost is situated near the base of a cliff.

Painted Cave Roost: This roost, located another half to one mile (0.8-1.6 KM) further up Capulin Canyon from the Capulin Roost, was used heavily and consistently by up to 10 bald eagles this winter. Within the roost area five known roost trees and 17 suspected of being roosts as evidenced by eagle sign were found, all Ponderosa pine. The majority of the trees (72%) were live while the remainder were snags (Table 4). The canyon is fairly wide at this point, running from northwest to southeast, and the Ponderosa growth is generally sparse. The most heavily used roost tree was a snag that appeared to be unprotected from winds.

Mid-Capulin Roost: This roost is also located in Capulin Canyon and stretches for about a mile (1.6 KM), three to four miles (4.8-6.4 KM) from the Rio Grande. The canyon here is much narrower than at the other Capulin Canyon roosts and the Ponderosa timber is also denser due to mesic conditions. In this area, six Ponderosas were known to have been used for roosting while 17 others showed signs of bald eagle use. Of the trees, 78% are snags (Table 4) which may be related to the protection from winds afforded by the narrow canyon and the dense timber. This roost area received use consistently all winter by up to 10 eagles.

Medio Roost: This roost was not known to have been used by bald eagles this winter. Two Ponderosa pine snags showed signs of use and since it is unlikely that they are perch trees, they are felt to constitute a roost area which possibly has been used in years past. The roost is situated in Medio Canyon about 2.3 miles (3.7 KM) from the Rio Grande. The canyon bottom is sparsely vegetated with Ponderosa and juniper and is fairly narrow.

Rio Chama Study Area

Six different roost areas were identified in the Rio Chama study area and there is some indication that more may exist. These roosts were used to varying degrees by bald eagles, some frequently visited while others received sporadic use. The characteristics of each area are summarized in Table 5 and locations are shown in Appendix C.

Monastery Roost: This roost site is located within the ¼ mile (0.4 KM) wide flood plain of Chama Canyon just to the north of the Monastery of Christ in the Desert. This roost received its heaviest use during the period of high bald eagle numbers in late February and throughout the rest of the winter it appeared to be used sporadically by eagles. One large overmature Ponderosa was utilized for roosting and no other trees showed signs of use (Figure 14). This live tree is the dominant tree in the fairly dense stand of pine and

Table 5. Bald eagle roost tree summary by roosting area for Rio Chama study area. All trees Ponderosa Pine.

Roost Area	No. Trees Used	No. Trees in Condition Class*					$\bar{X}$ Ht.	$\bar{X}$ DBH	Relative Degree of Use
		1	2	3	4	5	ft. (M)	in. (cm)	
Monastery	1	0	0	0	0	1	129.0 (39.3)	42.5 (107.9)	Light-Heavy; Sparadic
Golondrino**	At Least 1	0	0	0	0	1	--	--	Moderate; Sparadic
Gallina	3	0	0	0	0	3	119.0 (36.3)	39.8 (101.1)	Moderate; Consistent
Cooper	5	0	0	0	3	2	64.4 (19.6)	23.2 (58.9)	Moderate; Consistent
Chama	1	0	0	0	0	1	82.0 (25.0)	25.0 (63.5)	Moderate; Consistent
El Vado	3	0	0	0	0	3	98.3 (30.0)	28.8 (73.1)	Heavy; Sparadic
Total or Grand Mean	14	0	0	0	3	11	76.0 (23.2)	30.0 (76.2)	

* Condition Classes: 1 = dead, top intact; 2 = dead, top broken; 3 = live, top broken; 4 = live, top intact but dead; 5 = all live

**Roost area inaccessible, no trees measured

Douglas fir with an understory of juniper. The roost is 100 yards (92 M) from the Rio Chama and is within one of the two bald eagle high use areas in the canyon. The roost is provided little protection from the canyon walls though some is affored by the surrounding large conifers.

Golondrino Roost: This sporadically used roost area is located about two miles (3.2 KM) north of the Monastery Roost and is in a fairly dense stand of Ponderosa pine and Douglas fir at the mouth of a small west running side canyon. The site is on the west side of the Rio Chama, only 50 yards (46 M) away, and was inaccessible once the level of the Rio rose in March and hence, no trees were measured. Only one large Ponderosa was known to have been used on occasion but other trees may have been used. The site is partially protected by the canyon walls at the mouth of the side canyon and also by the timber. Like the Monastery Roost, it is located within a high use area. Only one bald eagle was observed using the roost indicating that it may not be a communal roost. The social function of a communal roost is that of acting as an "information center" to aid birds in locating food where it is limited in abundance or distribution (Ward and Zahavi 1973). When unfrozen, the Rio Chama seems to supply an abundant, evenly distributed food supply, and when frozen over eagles appear to rely heavily on rabbits (see Food Habits) which also are quite abundant and widely distributed. These two factors may lessen the need for communal roosting though this is only conjecture.

Gallina Roost: Three large, overmature Ponderosa pine trees make up the Gallina Roost which is located on the bank of the Rio Chama where the flood plain is less than 100 yards (92 M) wide. The roost was used fairly regularly by up to three eagles and is situated in a dense stand of Ponderosa pine and Douglas fir, which provide most of the protection from wind at this site. There is some indication that this roost is preferred to the Golondrino Roost

as an adult eagle was observed on one occassion flying from a point near the Golondrino site towards the vicinity (view of Gallina site blocked) of the Gallina Roost after sunset. This roost is located on private lands surrounded by U.S. Bureau of Land Management land.

Cooper Roost: The Cooper Roost, located on the east rim of Chama Canyon just north of its confluence with Nutrias Canyon, was used regularly throughout the winter by at least two eagles. The five Ponderosa pine trees which showed evidence of use by eagles are all located near the rim, in a shallow depression below a ridge which provided some limited protection from winds. The stand of Ponderosa in which the area is situated is relatively sparse and the timber has been stunted by a fire which passed through the area in the past. The roost trees are all generally much smaller than the trees in the other roost areas (Table 5). This roost would appear to give eagles an excellent view of the surrounding terrain and be far above any cold air drainage which may occur at night in the canyon below.

Chama Roost: This roost consists of a single overmature Ponderosa pine located at the base of the east canyon wall below a sheer cliff, only 25 yards (23 M) from the Rio Chama. Due to its situation near the cliff in somewhat of a bend in the canyon, the roost is well protected from winds. The roost received consistent utilization by two adult bald eagles. This roost, as well as the Cooper Roost, is located on private land. The roost tree has also been used as a day time perch and eagles frightened from other perch trees frequently flew into this tree, apparently feeling more secure here. Coffey (1977) also observed similar behavior by disturbed birds.

El Vado Roost: Use of this roost was not observed until the first week in March and was only observed one evening. The roost is located on a steep southwest facing slope below a ridge top overlooking El Vado Dam. Three mature to overmature Ponderosa pine trees showed signs of bald eagle use and

others may have been used. The stand in which the site is found is dense with little understory and is dominated by Douglas fir with scattered large pines. Douglas firs possibly are not utilized due to a general lack of the approach "windows" and dense branching in the crowns.

There was some speculation early in the winter that bald eagles may have been roosting in Huckaby Canyon east of the Rio Chama on Carson National Forest lands. No such use of this side canyon was noted this winter, however. Other large, heavily wooded side canyons such as Mine and Dark Canyons were initially suspected of harboring bald eagle roosts, but this was not borne out during the study.

FORAGING AREAS AND AVAILABLE PREY BASE

Foraging areas within the study areas were considered by the type of prey base available to bald eagles, either aquatic (those species associated with water) or terrestrial (those not associated with water). In most cases limited foraging by eagles was observed in terrestrial foraging areas and were delineated in more general terms than were the aquatic areas.

Rio Grande Study Area

Aquatic Foraging Areas and Prey Base: In the Rio Grande study area, the entire length of the Rio and Cochiti Lake provide aquatic foraging habitat for eagles. Above Cochiti Lake foraging observations were very limited. At the lake, undoubtedly the most important foraging area, numerous observations were made of foraging eagles. Below Cochiti Dam several attempts by eagles to catch aquatic prey were noted. One other area which appears to have been utilized for foraging by eagles, though no actual observations were made, is that portion of the Santa Fe River basin just east of the spillway at Cochiti Dam. Water has accumulated in the low areas here and a marshy situation has been created. This area has great potential for habitat improvement.

The available aquatic prey base in the study area includes several species of fish and waterfowl. The Rio Grande and Cochiti Lake sustain a great diversity of fish including: carp (Cyprinus carpio), brown bullhead (Ictalurus nebulosus), channel catfish (I. punctatus), largemouth bass (Micropterus salmoides), bluegill (Lepomis macrochirus), crappie (Pomoxis spp.), walleye (Stizostedion vitreum) and rainbow trout (Salmo gairdnarii). American coots (Fulica americana) were abundant at Cochiti Lake and often were very concentrated in the openings in the frozen surface of the lake (Figure 7). Few coots were found elsewhere on the Rio Grande. At Cochiti Lake the most common waterfowl species were: common merganser (Mergus merganser), goldeneye (Bucephala clangula) and Canada goose (Branta canadensis), though some mallards (Anas platyrhynchos) and green-winged teal (A. carolinensis)were observed as well. Below the dam several species of dabblers were most abundant: mallard, teal, pintail (A. acuta), gadwall (A. strepera) and American wigeon (A. americana). Above Cochiti Lake, mergansers, goldeneyes and mallards were most frequently seen. Several species of ducks were noted, as well as coots, at the Santa Fe River foraging area.

Terrestrial Foraging Areas and Prey Base: All areas stretching on either side of the Rio Grande and surrounding Cochiti Lake are considered to comprise terrestrial foraging habitat for bald eagles. It is only conjecture as to how far this habitat extends from the Rio Grande but it is not to unreasonable to assume that eagles may range as far as ten miles or more in search of food.

The available prey base in the study area includes mainly carrion and small mammals. Carrion in the area consists largely of mule deer (Odocoileus hemionus), of which five carcasses were found near trails this winter. Feral burros (Equus asinus) also account for some carrion and one carcass was noted this winter. Elk (Cervus canadensis) may also provide a source of carrion,

though its range is further from the Rio Grande than the other sources. Small mammals which eagles may prey upon include cottontail rabbit (Sylvilagus spp.) and blacktailed jackrabbits (Lepus californicus). Cottontails appear to be much more abundant than hares in the study area. Several other species of small to medium sized mammals were seen in the area but their scarcity or habits make them unlikely targets for eagles.

Rio Chama Study Area

Aquatic Foraging Areas and Prey Base: In the Rio Chama study area fish appear to be a much more important aquatic constituent of the eagle diet than along the Rio Grande, mainly due to a lack of other aquatic prey species. The entire length of the Rio, especially when unfrozen, provides excellent foraging habitat for eagles. El Vado and Abiquiu Lakes were frozen over most of the winter and supplied minimal foraging habitat.

Available prey items include four species of fish and a few scattered waterfowl. Fish species include carp, channel catfish, brown bullhead and rainbow trout. Waterfowl numbers were low and occurred mainly near El Vado Dam and included mallards, goldeneyes, common mergansers, buffelheads (Bucephala albeola) and ring-necked duck (Aythya collaris). One other species associated with water and present in the area (only one seen all winter) is great blue heron (Ardea herodias), considered a prey item for reasons to become apparent further in the report.

Terrestrial Foraging Areas and Prey Base: Like the Rio Grande study area, those areas to each side of the Rio Chama provide terrestrial foraging habitat for bald eagles, though it is impossible to estimate how far the eagles range. Eagles from the Rio Chama area may be foraging on the northern part of the Cuba Ranger District as eagles were seen flying up the Rio Gallina, possibly headed for the Cuba R.D.

The available terrestrial prey base here also includes carrion and small

mammals. One other terrestrial species which is considered possible prey for eagles is the turkey (Meleagris gallopavo). Turkeys were common along the Rio Chama this winter and often fed on the open banks oblivious to everything around them, making them easy marks for attack by eagles. Carrion in the area is supplied chiefly by mule deer and elk. Small mammal species which are preyed upon by bald eagles include cottontail rabbit and black-tailed jackrabbit, though no hares were seen in the study area.

FOOD HABITS AND FORAGING METHODS

Wintering bald eagles are often characterized as opportunistic hunters and are known to take a wide range of prey species. Just as their food habits are quite varied, so are the methods eagles utilize to find and capture prey.

RIO GRANDE STUDY AREA

Food habits of bald eagles in the Rio Grande study area are summarized in Table 6 and Figure 15. American coots were by far the single most important food item in the study area (Figure 15). Coots made up almost 57% of the total diet. Of all the observed successful kills by eagles in the area, coots made up 87%. This is related to a combination of factors: their high abundance in the area and the relative ease eagles generally exhibited in catching them. Coots made up the bulk of wintering diet of eagles in other areas, including southern California (Coffey 1977), Florida (Bent 1937) and northern Arizona (pers. obs.). Ducks constituted 22% of the total and of this, 12% were Anas spp.(mallard, teal, pintail, etc.) and only 1.4% commom merganser.

Fish made up only 1.7% of the total though its importance may be underestimated due to biases related to the lack of fish remains in castings. In any case, it is felt that fish bears relatively little importance in the bald eagle diet in the area. In all, aquatic food items made up a substantial 80.4%

Table 6. Rio Grande study area bald eagle food habits.

Prey Item	No. Castings	No. Remains	Observations	% Total
Mule Deer	32	8	-	10.9
Burro	9	1	-	2.7
Cottontail	-	2	-	0.5
Unidentified Lagomorph (cottontail or hare)	14	2	-	4.3
Unidentified Mammal	4	-	-	1.1
TERRESTRIAL SUBTOTAL	59	13	0	19.6
American Coot	136	52	20	56.7
Anas spp.	42	3	-	12.3
Merganser	3	2	-	1.4
Unidentified Duck	30	1	-	8.4
Rainbow Trout	-	-	1	0.3
Carp	1	-	-	0.3
Brown Bullhead	-	1	-	0.3
Unidentified Fish	1	-	2	0.8
AQUATIC SUBTOTAL	213	59	23	80.4
TOTAL	272	72	23	100.0

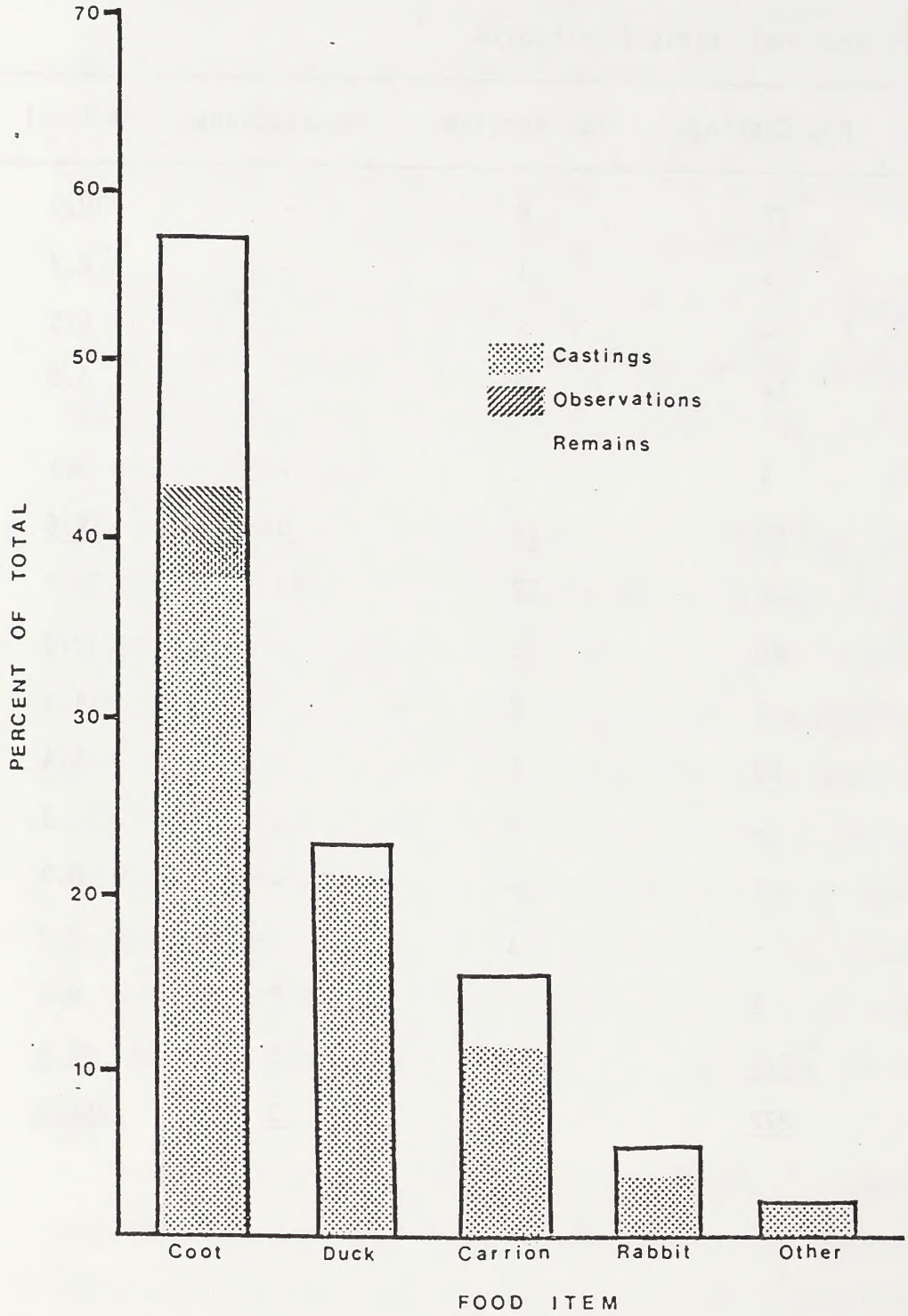

Figure 15. Constituents of the bald eagle diet in the Rio Grande study area determined from observations, castings and food remains.

of the total food habits.

Carrion accounted for a surprising 14% of the total since it is generally agreed that carrion is a supplement to the diet when "preferred " foods become scarce. This, however, was not the case and this may well illustrate the opportunistic nature of the bald eagle in that it is readily willing to feed on whatever is present. Mule deer made up 11% of the total and burro carrion the other 3%. Cottontail rabbit and unidentified lagomorph (both rabbit and hare) accounted for 5% of the total and all terrestrial species summed up made up 19.6% of the total food habits.

A wide variety of foraging methods were exhibited by bald eagles to obtain prey, some which were very similar to those described by Southern (1963), Munro (1938), Bent (1937) and Coffey (1977). When foraging for coots the eagles used three distinct methods with numerous variations:

1) Eagles approached a thick mass of coots flying low over the ice or water and without circling, flared and struck at a coot. The coots reacted to this approach by eagles generally by moving away, but not actually leaving the water, staying in the tight mass. This meant that the eagle usually still had a good chance in catching a bird instead of if the coots had dispersed from the group (it often seemed that the eagles aimed and struck at the mass versus singling out a particular bird). This was the most frequently observed method.

2) An eagle would circle over a mass of coots, gradually losing height until 10-15 feet above the coots, where it would drop with wings stretched upward (not a typical stoop) and talons extended to strike at a coot. Coots generally reacted to eagles employing this tactic in a similar manner to the above method.

3) Eagles perched in trees or on the ice would wait for a single or a few coots to leave the large mass and would generally employ method 1) from above to strike at the seperated coot(s). When coots became isoloated like this, especially if on the ice, eagles had an excellent success rate in obtaining a meal. In one extreme instance, an eagle actually "ran down" a lone coot by chasing it across the ice for some distance before catching it.

Only on one occasion were bald eagles observed enganging in what might be considered cooperative hunting. Two immatures were observed circling over a large flock of coots and each made alternate drops (as in method 2) until

one was finally successful. It was not obvious as to whether one eagle was "herding" the coots for the other as described by Coffey (1977) but it is certainly a distinct possibility.

Bald eagles obtained coots in one other intriguing, if not amusing, manner, though it does not really constitute a foraging method. On one occasion, a coyote (Canis latrans) appeared on the ice at Cochiti Lake and began to chase coots which had grouped together on the ice. It caught one, killed it, dropped it to the ice and pursued another, repeating this three times leaving a string of dead coots stretching about 200 feet (61 M). As it chased each new coot after killing the previous, an eagle flew down and stole the coot, grasped it in its talons and flew away being pursued by many of the 14 eagles in the vicinity. All this was taking place unbeknownst to the hungry coyote! After three of its coots had been pilfered in this manner and the coyote paused with a fourth in its jaws, 8 immature eagles began circling just over and behind the coyote, waiting for it to drop yet another coot for them to steal. It was then that the coyote first noticed the eagles and clearly was startled, dropped its coot and bolted to the shore where it cowered under a juniper bush. Needless to say, the eagles stole the fourth coot with a wild melee ensuing. After about five minutes, the coyote emerged from its hiding spot and again began to hunt coots, only in a much altered manner. This time it would catch a coot, take it to shore to eat before returning to the ice to kill another. No other interaction was noted between the coyote and the eagles. The only other report of any kind of interaction between coyotes and bald eagles was made by Wells and Bekoff (1978) where one eagle passively kept five coyotes from returning to a domestic cow carcass on which they had been feeding when the eagle appeared. The coyotes in this case were in a majority but they still exhibited the same kind of respect for the bird as the coyote at Cochiti Lake.

Eagles foraged for ducks in much the same manner as they did for coots, but they were never observed to be successful. This may be due to the fact that eagles usually tried to catch mergansers which were nowhere near as abundant as coots and were also very adept in escaping attack by diving and surfacing in a different spot (if coots dived, they usually surfaced in the same spot and were often caught after repeated attempts by eagles). Eagles occasionally seemed to try and "second guess" the mergansers by hitting the water a good distance from where the bird disappeared, anticipating that the duck would surface at this spot. This was unsuccessful whenever it was used as the mergansers usually surfaced a good distance away.

Observation of fishing attempts was quite limited, only three seen, but all were made in the same manner and by the same immature eagle (the one with the large gap in one wing). The eagle flew or circled slowly over the water about 30 feet below, dropped down with wings held high or swooped down and struck the surface of the lake with its talons. This eagle was successful 67% of the time.

There is some indication that ravens (Corvus corax) may help bald eagles in locating carrion which they feed on. Near a burro carcass, over 80 ravens were circling which led me to the carcass. A deer carcass was found in a similar manner though nowhere as many ravens were at the carcass. It is plausible then that eagles also key on the presence of large numbers of ravens to locate carrion.

RIO CHAMA STUDY AREA

Food habits of bald eagles in the Rio Chama study area are summarized in Table 7 and Figure 16. Fish made up a total of only 17% of the food habits in the area, a figure which is probably grossly underestimated due to bias induced by the high degree digestibility of fish, resulting in

Table 7. Rio Chama study area bald eagle food habits.

Prey Item	No. Castings	No. Remains	Observations	% Total
Mule Deer	1	3	-	5.80
Elk	-	2	-	2.90
Unidentified Lagomorph (cottontail and hare)	40	4	-	63.80
Unidentified Mammal	-	1	-	1.45
Turkey	-	1	-	1.45
TERRESTRIAL SUBTOTAL	41	10	0	75.40
Rainbow Trout	-	-	1	1.45
Carp	-	1	-	1.45
Brown Bullhead	-	1	-	1.45
Catfish	-	-	1	1.45
Unidentified Fish	3	5	-	11.60
Great Blue Heron	-	1	-	1.45
Anas spp.	-	1	-	1.45
Unidentified Duck	1	2	-	4.30
AQUATIC SUBTOTAL	4	12	2	24.60
TOTAL	45	22	2	100.00

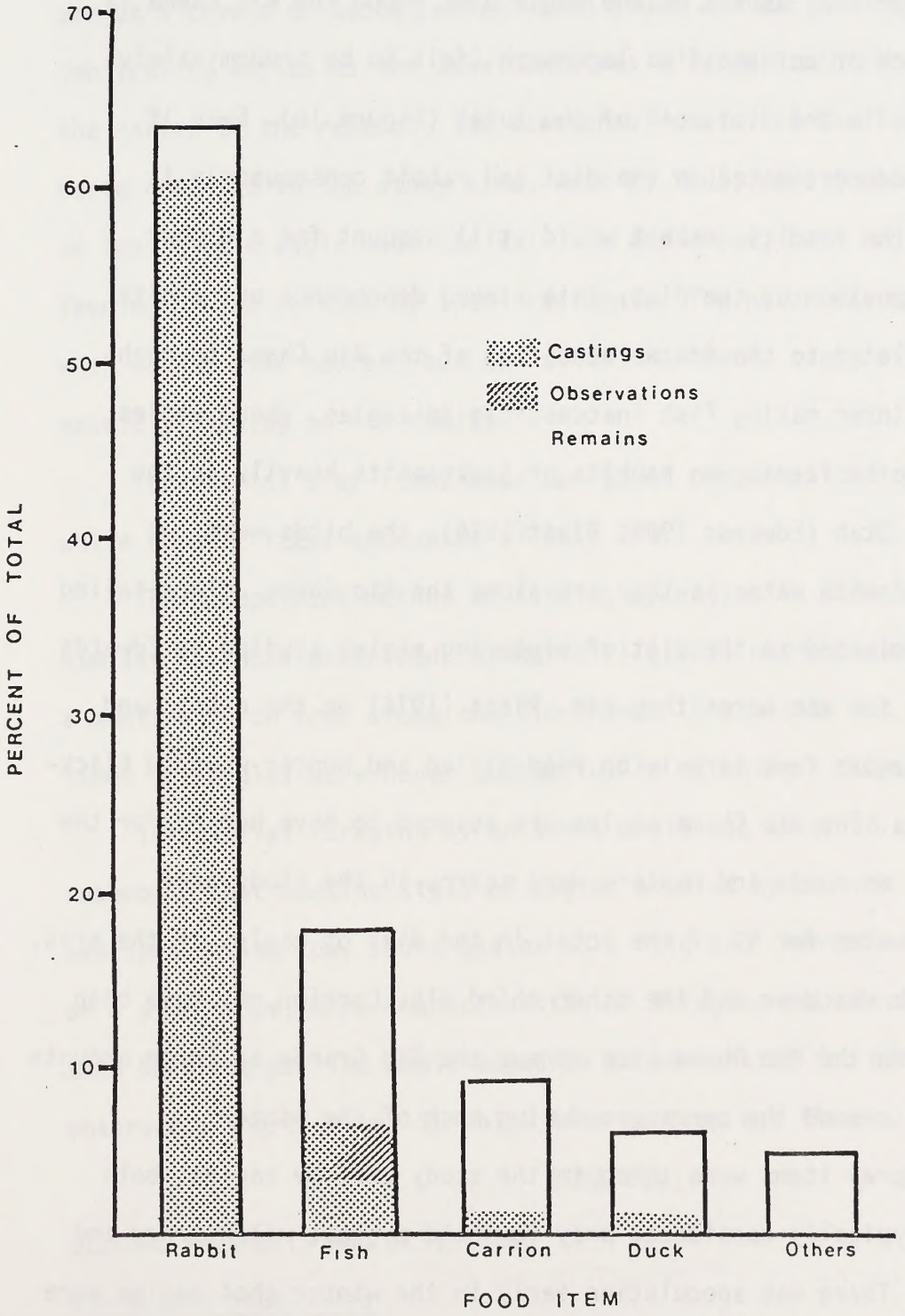

Figure 16. Constituents of the bald eagle diet in the Rio Chama study area derived from observations, castings and food remains.

no castings. It is to be stressed that fish probably make up a much greater portion of the diet than this winter's results indicate, though how much more important is not known.

The most surprising aspect of the eagle diet along the Rio Chama is the high occurrence of unidentified lagomorph (felt to be predominately cottontail rabbit) in the diet, 64% of the total (Figure 16). Even if fish is grossly underestimated in the diet and rabbit consequently is overestimated by the results, rabbit would still account for a higher than expected proportion of the diet. This strong dependence on rabbits is undoubtedly related to the frozen condition of the Rio Chama throughout most of the winter, making fish inaccessible to eagles. Where eagles have been found to be feeding on rabbits or jackrabbits heavily in the winter, mainly in Utah (Edwards 1969, Platt 1976), the birds were not closely associated with water as they are along the Rio Chama. Black-tailed jackrabbits predominated in the diet of wintering eagles studied by Edwards (1969) and hunted for the hares they ate. Platt (1976) on the other hand found that bald eagles feed largely on road-killed and hunter wounded black-tailed jackrabbits. The Rio Chama eagles are assumed to have hunted for the rabbits and hares as roads and hunters were scarce in the study area.

Carrion accounted for 9% of the total in the diet of eagles in the area, of which two thirds was deer and the other third elk. Carrion may have been harder to locate in the Rio Chama area versus the Rio Grande as large amounts of snow may have covered the carcasses during much of the winter.

Two unsual prey items were taken in the study area by eagles, both large birds not typically considered prey for bald eagles; wild turkey and great blue heron. There was speculation early in the winter that eagles were preying on turkeys, as remains consisting mainly of scattered feathers were found on two occasions, though mammalian predators may have been responsible.

However, the remains of a recently killed turkey were found in early March which consisted of the legs, rib cage, pelvic region and wings, all which had been meticulously cleaned of flesh (much as though an eagle would eat versus a coyote or bobcat, which would crush and eat the bones). Further implicating eagles as the assailants was a large "splotch" of whitewash in the center of the remains. The scattered remains of the lone great blue heron observed in the study area, near El Vado, were found and it is assumed that a bald eagle made the kill. In any event, bald eagles were observed feeding on the carcass by local residents. The heron was usually very wary when eagles flew nearby, but on occasion showed signs of habituation, possibly leading to its demise.

Terrestrial prey items made up 76% of the total diet in the Rio Chama while aquatic items accounted of only 24%.

The predominant method of fishing by eagles in the study area is similar to those described by Retfalvi (1965) where they made a stoop from a hunting perch tree along the Rio Chama. This method was observed several times but eagles were never successful in catching a fish.

Terrestrial foraging by an adult eagle was observed once and closely resembled that hunting style of eagles studied by Edwards (1969). The bird was seen making low, short passes in a "zig-zag" manner over the vegetation on a side slope, more characteristic of foraging methods employed by harriers than bald eagles. The eagle appeared to be hunting for rabbits and was only observed a short while, in which time no prey was flushed from the vegetation.

BEHAVIOR

DIURNAL MOVEMENTS AND ACTIVITIES

Rio Grande Study Area

Daily activities in the Rio Grande area began in the early morning, when bald eagles started leaving the roosts, usually about a half hour prior to

sunrise, though often later, especially during storms. They generally left the roost one at a time in a fairly steady procession and then flew out over White Rock Canyon, via well defined travel corridors, and began to soar. The early morning soaring was a set ritual and lasted from 2-15 minutes. The eagles then continued on down White Rock Canyon to Cochiti Lake where they landed on the ice (if present) or in the perch trees, typically in small groups of 4-6. Foraging activity was most intensive during an hour to an hour and a half period after arriving at the lake, and throughout the remainder of the day loafing was the dominant activity. When the lake was frozen over, eagles often made frequent forays to the Santa Fe River foraging area or flew south over Cochiti Dam but usually returned within an hour. When unfrozen, eagles still assembled at the lake in the early morning but most would then leave the area and head over the dam to spend the day in the cottonwoods along the Rio Grande. Occasionally, foraging attempts were made or eagles switched trees, but here, loafing was the predominant activity. Whether the lake was frozen over or not, there was usually an increase in hunting activity in the late afternoon. Eagles typically left for the roost areas about a half hour after sunset, though often departed earlier, especially during inclement weather. Other activities in the area did not readily fit a pattern, however, soaring by eagles was often observed in the vicinity of the Alamo Bottoms Roost on very windy days, much more so than on calm days. Servheen (1975) also noted an increased amount of soaring by bald eagles on windy days.

Rio Chama Study Area

Diurnal activity and movements were more difficult to determine here due to the dispersed nature of the eagles, and hence, are more generalized in description than along the Rio Grande. The day also began here when eagles left the roosts and proceeded to perch trees near or along side the Rio Chama. No intensive early morning foraging was observed here, rather foraging

attempts were made by eagles throughout the day. Loafing constituted the major activity in the study area, as along the Rio Grande. Then, usually a half hour or so before sunset, eagles flew to the pre-roosting staging trees where they would remain until a half hour after sunset when they departed for the roost.

INTRA- AND INTERSPECIFIC INTERACTIONS

Intraspecific Interactions

Intraspecific interaction between bald eagles was noted in the foraging, perching and roosting areas. In the foraging areas, interaction was most spectacular when one eagle caught a coot at Cochiti Lake, as a wild chase and fight usually ensued. Most of the 10-15 eagles at the lake joined in the antics which often end up with a rolling ball of eagles on the ice, with the coot changing hands (or talons) numerous times. A great deal of mantling was exhibited by eagles which held the prey or part of it. Servheen (1975) states that the aggregation of eagles at concentrated food sources could serve the social function of minimizing intraspecific combat and energy loss. Eagles in the Rio Grande study area appear to prefer letting some other eagle catch a coot and then taking their chances in getting a share during the chase and fight. The one exception was when adults caught or stole a coot from an immature; then little, if any, fighting was observed.

In the perching areas, intraspecific interaction consisted mostly of the supplanting of eagles in a perch tree or on the ice by newly arriving birds. It seems that eagles preferred to supplant another from a limb rather than land next to it. This behavior was characterized by an attack-like approach by the supplanting bird which occasionally even struck the perched bird, resulting in its leaving the perch. When immatures supplanted another immature, the superseded bird would either return and land next to the other,

supplant the bird which supplanted it or provoke a chase. When adults supplanted immatures at a perch, little resistance was exhibited by the immature and it seldom returned to the perch. Though data is limited, adults were usually perched higher or in a more favorable perch location than immatures, when both were perched in the same tree.

Interaction between bald eagles in the roost areas was characterized by supplanting of immatures by adults from roost trees. Immatures were supplanted from the Chama Roost on two occasions by adult eagles and immatures at the Capulin Roost used the area for staging only, while adults roosted there regularly. Several eagles utilized the same preferred roost trees and a good deal of shifting about was observed when each new bird flew into the tree.

Interspecific Interaction

Interspecific interaction was noted between bald eagles and ravens, gulls (Larus spp.), a red-tailed hawk (Buteo jamaicensis) and golden eagles (Aquila chrysaetos). Of these species, ravens were most commonly seen interacting with eagles, especially when they were feeding. Ravens often waited within inches of feeding eagles to pick through any remains which might have been left. At perches, ravens would land and perch in close proximity to eagles. Frequently, eagles were harassed by ravens at perches and when flying, and eagles sometimes acted in an aggressive manner, by giving chase and trying to strike them, but ravens were far too agile to be seriously threatened.

Gulls at Cochiti Lake were frequently seen in association with eagles, feeding on small bits and pieces of coot strewn about the ice. Never were eagles observed stealing food or even chasing gulls as Erskine (1968) noted. Gulls, in general, were not quite so impetuous as ravens and usually kept their distance from eagles.

Observation of interactions between bald eagles and red-tailed hawks

were limited to one brief encounter between an adult eagle and hawk. The hawk was perched in the top of a favored spike-top eagle perch tree, when the eagle approached the tree, flared with its talons extended and forced the hawk from the perch. It gave chase a short distance, circled back and landed in the tree. The red-tailed hawk remained undaunted and circled back by the eagle and landed in another spike-top tree only 100 feet (31M) away (in Figure 10, the hawk can be seen in the top of the tree to the left of the one with the bald eagle).

Interspecific interaction between bald and golden eagles was limited to that of soaring together. This was observed on warm days when the birds were soaring in warm air thermal radiating from the walls of Chama Canyon.

LEARNING BY BALD EAGLES

Just how much of the bald eagle's selection of habitat, use of different hunting methods and other wintering area parameters is instinct, and how much is learned is difficult to ascertain. There is indication that learning plays an important part in the survival of bald eagles in wintering areas. It was already mentioned how learning seems to be involved with the recent and increasing use of the Rio Grande study area. The eagles have exhibited flexibility in being able to search out and find suitable wintering areas when others have possibly been destroyed or degraded. This has obvious adaptive advantages over instinct in this respect.

Early in the winter, eagles used many different trees within the roost areas. But as winter progressed, fewer and fewer were used, as eagles presumingly learned which trees afforded superior protection, access, etc. Perhaps the low, early use of the Sanchez Roost as well as the Medio Roost, which may have received undetected use early in the

winter, were avoided once eagles learned that other, more attractive sites existed.

The foraging and hunting capabilities of bald eagles also appear to be governed heavily by learning. Early in the winter (January) eagles showed poor success, catching only 2 coots out of 15 attempts (13% success). Only a month later, under similar conditions, eagles were much more adept at taking coots and were successful on 18 of 25 attempts (72% success). Only learning and adapting of hunting methods can account for such a dramatic increase in hunting success.

DISTURBANCE FACTORS

One of the important goals of the study was to determine and document any disturbance factors which may have affected bald eagle use this winter and their continued use of the areas in the future. Disturbances were seperated into two general categories; direct and indirect. Direct factors are those which occur in the wintering area while eagles are present, usually result after a direct confrontation with eagles and are short term in nature. Indirect disturbances do not directly disturb the eagles but have their greatest influence on the habitat which may result in changes in eagle use patterns. These factors are generally long term in nature and may occur when eagles are absent (though not necessarily so) from the wintering areas.

RIO GRANDE STUDY AREA

In the Rio Grande study area, several disturbances were observed which affected, or may do so in the future, bald eagle use. Direct disturbance factors included those related to recreational use in the area (fishing, boating, etc.) and possibly human persecution by shooting. Indirect factors noted include habitat loss within the study area due to rising pool levels of Cochiti Lake, development in the area related to the Town of Cochiti Lake and habitat alteration related to recreational developments.

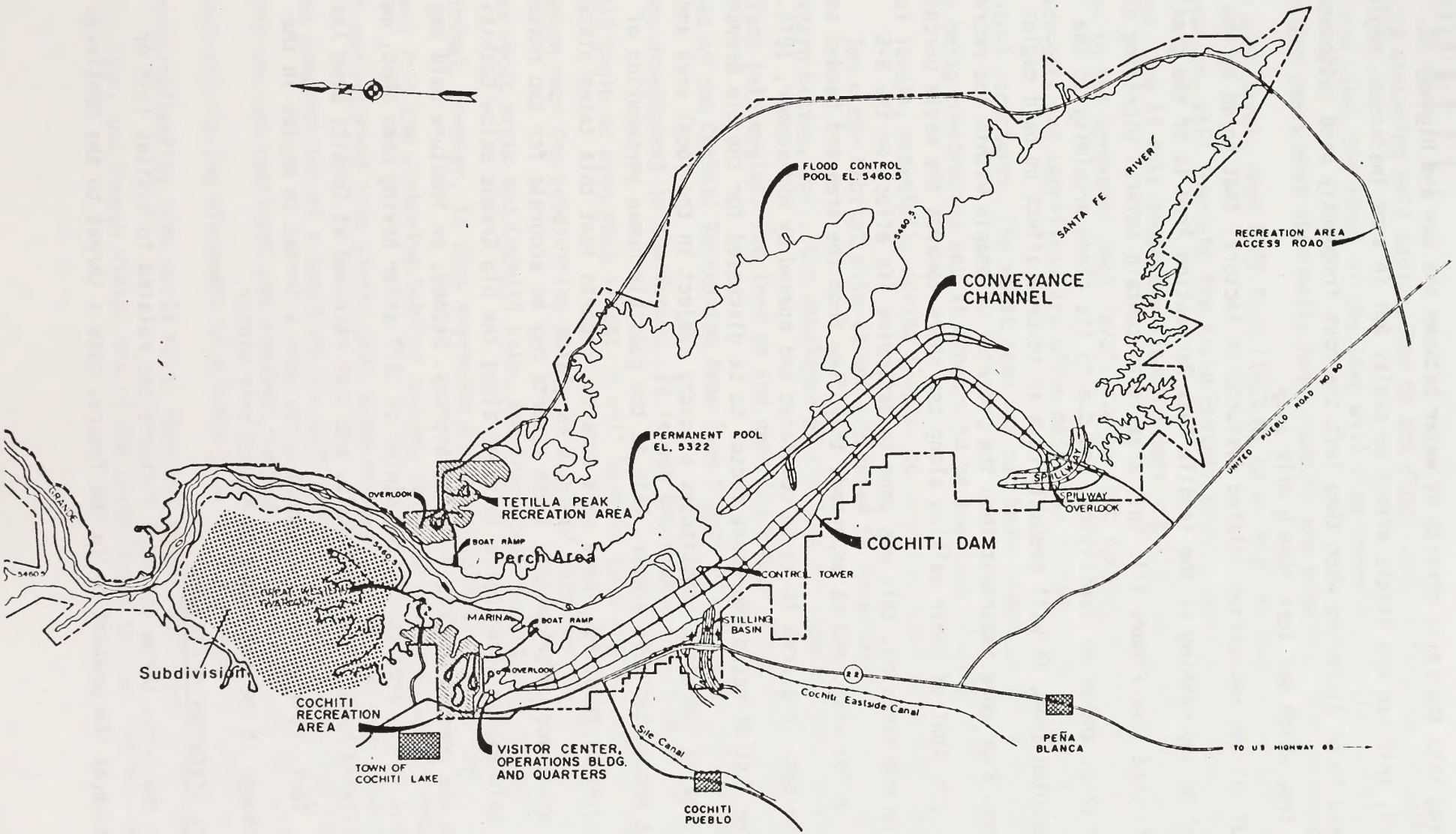

Figure 17. Map of Cochiti Lake showing recreational facilities, land subdivisio and bald eagle perch area on east shore. Map courtsey of U.S. Army Corps of Engineers, Cochiti Dam.

crowding into the ¼ mile strecth of water between the dam and Highway 22. In general, this use had little affect on eagles but in some instances, eagles appeared to be disturbed when they left the most frequently used cottonwood perch tree which was less than ¼ mile away.

Of all the recreation related disturbance factors, that posed by the future completion and opening of the Tetilla Peak Recreation Area is of the greatest significance (see Figure 17). This area is to contain several picnicing shelters, a boat ramp, and other facilities, and due to its close proximity to the high use perching area, it will probably have an adverse affect on bald eagles in the area. Even more important than the presence of people within the recreation areawill be that of their walking along the shore towards the eagle perching area. On one occasion, this was done to determine its affect on the 5-6 eagles in the area, and as expected, they flew from the area and headed south over the dam. This area is to be completed and opened by mid-summer, 1979.

The last direct disturbance factor to be discussed for the Rio Grande study area is one which constitutes a touchy subject in the local area and was not documented this winter. This is the possible human persecution of bald eagles by shooting. There were numerous reports that this takes place in the area, and unfortunately these reports may be accurate for two reasons. First, bald eagles often perch in trees along the Rio Grande below Cochiti Dam and are readily visible from the highway. Second, an immature bald eagle was found in the area during the winter of 1977 after having been shot, was rehabilitated by Dr. Phillip Schulz, and then released at Cochiti Lake last winter. Thus, it appears that shooting may pose a threat to eagles in the area, though it was not known to happen this winter.

Indirect Disturbance Factors

In the area, three indirect disturbances related to habitat loss or alteration,at the present or in the future, pose a threat to the continued

use by wintering bald eagles. Due to the flood control function of Cochiti Dam and Lake, the level of the lake will rise dramatically this spring and in other years when abnormally heavy runoffs are expected. This increase in the pool level, from 5322 feet (1623 M) to as high as 5460 feet (1665 M) in elevation, will inundate the Alamo Bottoms Roost, possibly killing the live trees. And if this temporary flooding does not kill the trees, the gradual rise in the permanent pool level, due to silt loading in the lake, will. Trade-offs and sacrifices are often made when society opts for such flood control structures. The roost area was not known about at the time the dam was being constructed and it appears to be too late to alter future lake pool levels, especially during floods, to save the roost area from inundation.

Two other habitat alterations are posed by developments slated by Great Western Cities, Inc., the developer of the Town of Cochiti Lake, which may affect bald eagles. The land on and near the rim of White Rock Canyon northeast of the Cochiti Recreation Area (see Figure 17) has been subdivided for home development in the future. It is not known when development in the area will begin or even what affect it will have on bald eagles. Eagles use the canyon near the subdivision mainly as a travel corridor for traveling between the roost areas and Cochiti Lake, and therefore, impact will probably be minimal. However, it does represent a new and obvious form of human encroachment into the wintering habitat and may make the area less attractive to eagles. It was reported this winter that Great Western Cities, Inc. was contemplating the construction of a beach on the east shore of Cochiti Lake, but admittingly, this was not confirmed and requires further checking into. It is quite obvious what affects the placement of a beach area in the middle of a high use eagle perching/loafing area would have. Numerous trees would have to be removed from the site, and though winter use of the beach would be low, the increased access

into the area would have a profound, adverse affect.

RIO CHAMA STUDY AREA

Due to the wilderness status of the SFNF portion of Chama Canyon, the lack of road access and harsh winters in the area, disturbance factors impact bald eagles relatively little here. Logging, road building and other indirect disturbance factors are restricted within the Chama Wilderness. Usually associated with wilderness areas are large amounts of recreational use in the form of hiking and backpacking, but even this is limited during the winter here, presumably due to harsh winter weather. Only one direct distubance factor was noted in the area, and its significance was low. Also, only one indirect disturbance factor was identified, and its importance is debatable.

Direct Disturbance Factors

With the warmer temperatures associated with the approaching of Spring, in mid March, came a rather steady increase in the number of people fishing at El Vado Ranch on the Rio Chama. The ranch is located within 20-50 yards (18-46 M) of several heavily used perch trees and eagles reacted minimally to human presence during the winter near the cabins. However, when people began to fish the river near the perch trees, use by eagles declined markedly. The overall effects of the presence of fishermen is felt to be minimal though, as it occurrs in a very limited area.

Indirect Disturbance Factors

The only indirect disturbance factor noted in the Rio Chama area is one which occurred prior to the initiation of the study, and therefore, any statements as to its impact are only conjecture. The U.S. Bureau of Reclamation is known to make sudden, large releases of water from El Vado Dam, in the neighborhood of an increase from 100 cubic feet per second (cfs) to 750 cfs or more. This occurred this winter only once, in December, when the Rio Chama was apparently frozen over. The large release resulted in the sur-

face of the river to be blasted apart and thrust onto the banks in such a manner to indicate that tremendous force is exerted when this occurrs. Pieces of the shattered ice were up to 15 inches (38 cm) thick and 5 feet (1.5 M) across, obviously weighing hundreds of pounds, and were thrown great distances from the river. Though having some undetermined affect on the riverside vegetation and bank erosion, the greatest disturbance is probably exerted on the fisheries in the river. The sudden releases may wreck havoc on the fish populations and the associated silting may affect both the fish and the ability of bald eagles to prey on them.

MANAGEMENT RECOMMENDATIONS

Management recommendations, in general, reflect the needs of the bald eagle in the wintering areas on the SFNF, emphasizing the need to maintain the integrity of the wintering habitat. Some of the recommendations follow guidelines for the primary and secondary zone concept (U.S. Forest Service 1977). One of the major problems affecting the effective implementation of the recommendations is the fact that several of them involve land use practices on lands other than those belonging to the SFNF.

GENERAL RECOMMENDATIONS

1) Promote cooperation between the SFNF and all agencies on which bald eagle use overlaps, including the U.S. Park Service, U.S. Army Corps of Engineers, Pueblo de Cochiti, U.S. Bureau of Land Management, U.S. Bureau of Reclamation and private landowners where applicable.
2) Monitor bald eagle use in the Rio Grande and Rio Chama areas to determine trends in future use and identify new disturbance factors which may develop. The SFNF and Region 3 of the Forest Service should continue it supply financial assistance to the New Mexico Department of Game and Fish for their aerial surveys. These flights are of great value in determining bald eagle population numbers and distribution.

3) Where possible, areas of consistent high use by bald eagles on non-SFNF lands, especially where the future continued use of the lands is jeopardized, should be acquired by the SFNF.

4) Restrict the use of non-target poisons, such as thallium sulfide, to control coyote populations within the Rio Grande and Rio Chama study areas. Bald eagles, such as the adult released at Cochiti Lake after recovering from poisoning, may feed on carcasses laced with poisons.

5) Write and intergrate a bald eagle management plan for the SFNF which coordinates activities between all disciplines.

RIO GRANDE RECOMMENDATIONS

1) It is recommended that at least the eastern shore of Cochiti Lake, and preferably more, be classified as a primary mamagement zone, where only those activities which benefit or pose no threat to bald eagles will be allowed. Even though this is Cochiti Indian Reservation land (Figure 1), such a measure should be instituted, and under this proposed action are included several recommendations to ensure continued bald eagle use:

   a) Close the Tetilla Peak Recreation Area and road when completed, to public use during the period when bald eagle use at Cochiti Lake is evident. This action would be cost efficient in terms of recreational management during the winter in that low use during the winter would justify its closing. This represents the most important of the recommendations.

   b) Under the guidelines of a primary management zone, any activities such as construction of a beach, removal of perch trees or further construction of recreational facilities within the zone would be prohibited, unless done in a manner which would not adversely impact bald eagles.

   c) Though an extreme measure, it may be necessary to limit boater use on Cochiti Lake during periods where bald eagle numbers are high and the lake is unfrozen.

   d) Inherent in implementing any of the recommendations is the mutual cooperation between the Pueblo de Cochiti, the Corps of Engineers and the SFNF. It is sincerely felt that all parties involved wish to promote the well being of the bald eagle, which

should facilitate cooperation. Information and education programs should help inform and lessen the adverse public reaction to limitations placed on recreational use during the winter.

2) Recommendations concerning bald eagle use at Bandelier National are forthcoming in Terry Johnson's final report and hence, none are proposed in this report. SFNF cooperation with the Park Service should be strived for in implementing the recommendations.

3) Though not observed this winter, human persecution of bald eagles by shooting should be monitored, and if detected or suspected, law enforcement authorities should be notified.

4) The Santa Fe River area east of Cochiti Dam, suspected of being used as a foraging area by bald eagles, has great potential for habitat improvements by the SFNF. Habitat improvements benefiting waterfowl species would in turn benefit bald eagles, as well as waterfowl hunting enthusiasts. This area should be managed as a secondary management zone,as it constitutes an important area to eagles outside the recommended primary zone at Cochiti Lake. Hunting perches near the low, marshy area appear to be limiting, and consideration should be given to planting cottonwoods or willows or erection of artificial perches to remedy this situation.

RIO CHAMA RECOMMENDATIONS

1) The Rio Chama study area should be managed as a primary management zone, especially those areas showing high bald eagle use. This should be readily acceptable as the wilderness status of the SFNF portions already limits most detrimental activities. Those areas located on private lands where bald eagle use was high should be monitored, and if threats to continued eagle use are detected, consideration should be given to acquiring these areas. Information and education programs to imform the landowners of the

importance of their land to bald eagles may prove beneficial.

2) Habitat improvement measures which would enhance the aquatic food supply for bald eagles, waterfowl and fish, should be considered where feasible.

3) Reports of eagles being sighted in Chama Canyon on the SFNF during the summer warrant a thorough investigation to conclusively determine the existence and status of a year-round population.

4) The matter of the large, sudden releases of water from El Vado Dam should be pursued further with the U.S. Bureau of Reclamation. If other, less drastic methods can be utilized to make releases during the winter, they should be implemented.

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APPENDICES

Appendix A. Temperature data summary during the study at Rio Grande and Rio Chama study areas.

	Month			
	Dec. 1978	Jan. 1979	Feb. 1979	Mar. 1979
Rio Grande Study Area*				
Mean High, °F	44	36	50	58
Mean Low, °F	17	19	24	33
Monthly Mean, °F	31	40	37	46
Extremes				
High °F	58	48	67	68
Low °F	-14	- 3	11	22
Rio Chama Study Area**				
Mean High, °F	37	32	41	47
Mean Low, °F	5	5	1	16
Monthly Mean, °F	19	19	21	32
Extremes				
High °F	43	44	53	55
Low °F	-21	-31	-31	- 4

* Data from weather station at Cochiti Lake, N.M.; provided by U.S. Army Corps of Engineers

** Data from weather station at El Vado, N.M.; provided by Carl Cooper

Appendix B. Map (north and south halves) of Rio Grande study area showing habitat utilization areas. Map of south half has two overlays, A and B, while north half has one combining information of both.

Overlay A. Perching/loafing and roosting areas.

Overlay B. Relative degree of bald eagle habitat usage.

RIO CHAMA STUDY AREA

NORTH HALF

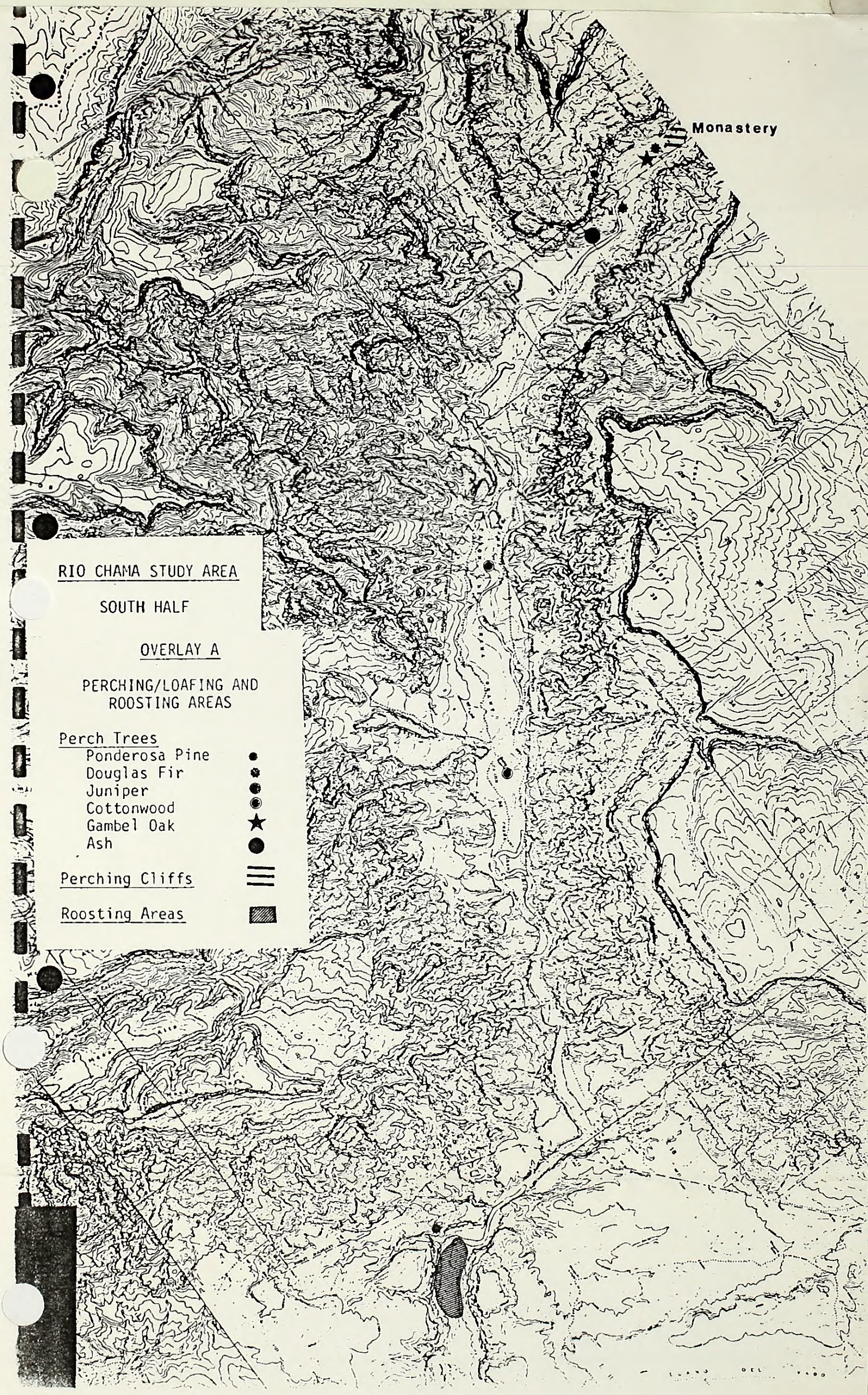
OVERLAY B

RELATIVE DEGREE OF
BALD EAGLE HABITAT USAGE

High Use

Moderate Use

Low Use



RIO CHAMA STUDY AREA

SOUTH HALF

OVERLAY A

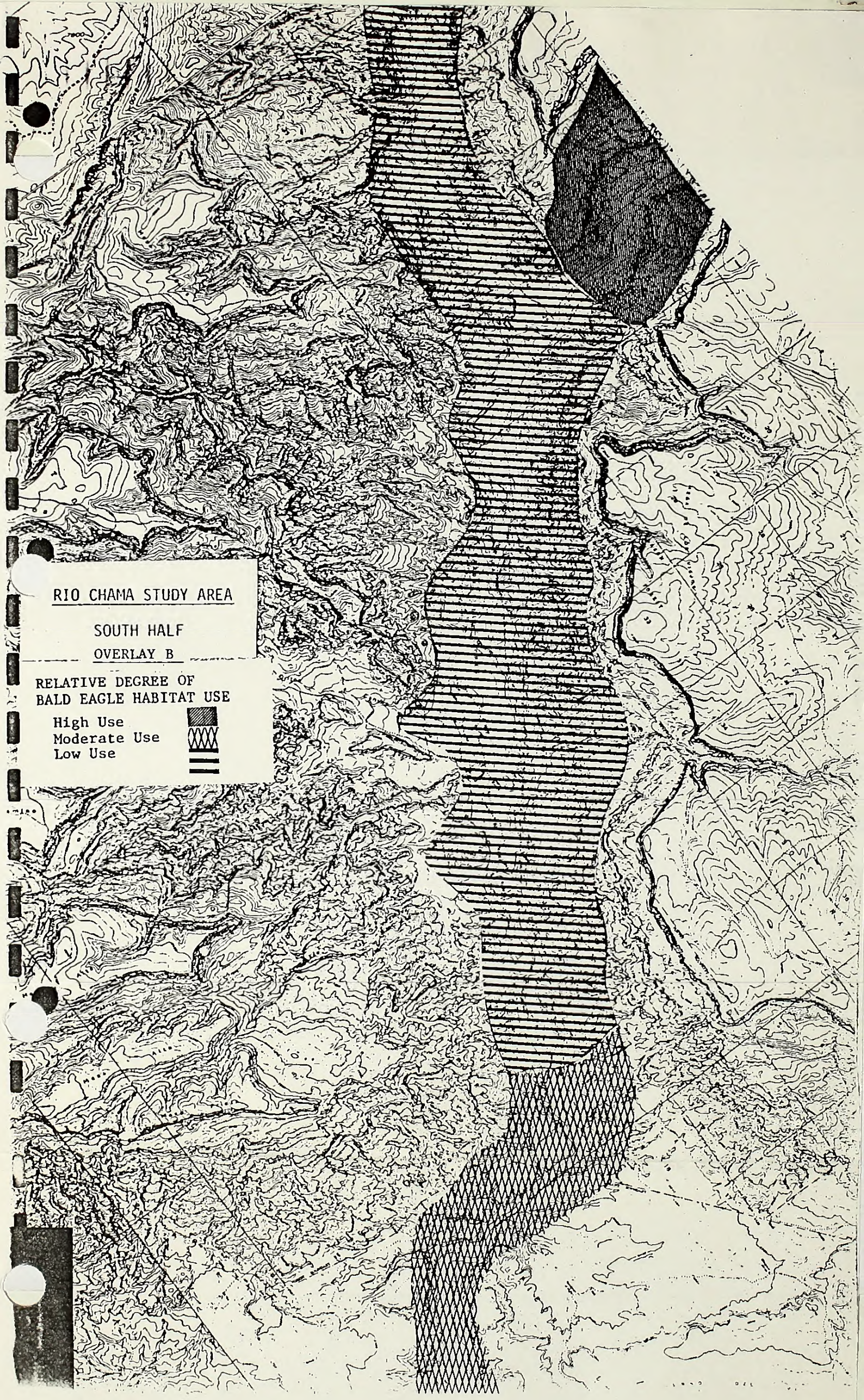
PERCHING/LOAFING AND ROOSTING AREAS

Perch Trees

- Ponderosa Pine
- Douglas Fir
- Juniper
- Cottonwood
- Gambel Oak
- Ash

Perching Cliffs

Roosting Areas


RIO CHAMA STUDY AREA
SOUTH HALF
OVERLAY B
RELATIVE DEGREE OF
BALD EAGLE HABITAT USE
High Use
Moderate Use
Low Use

R GRANDE STUDY AREA

NORTH HALF

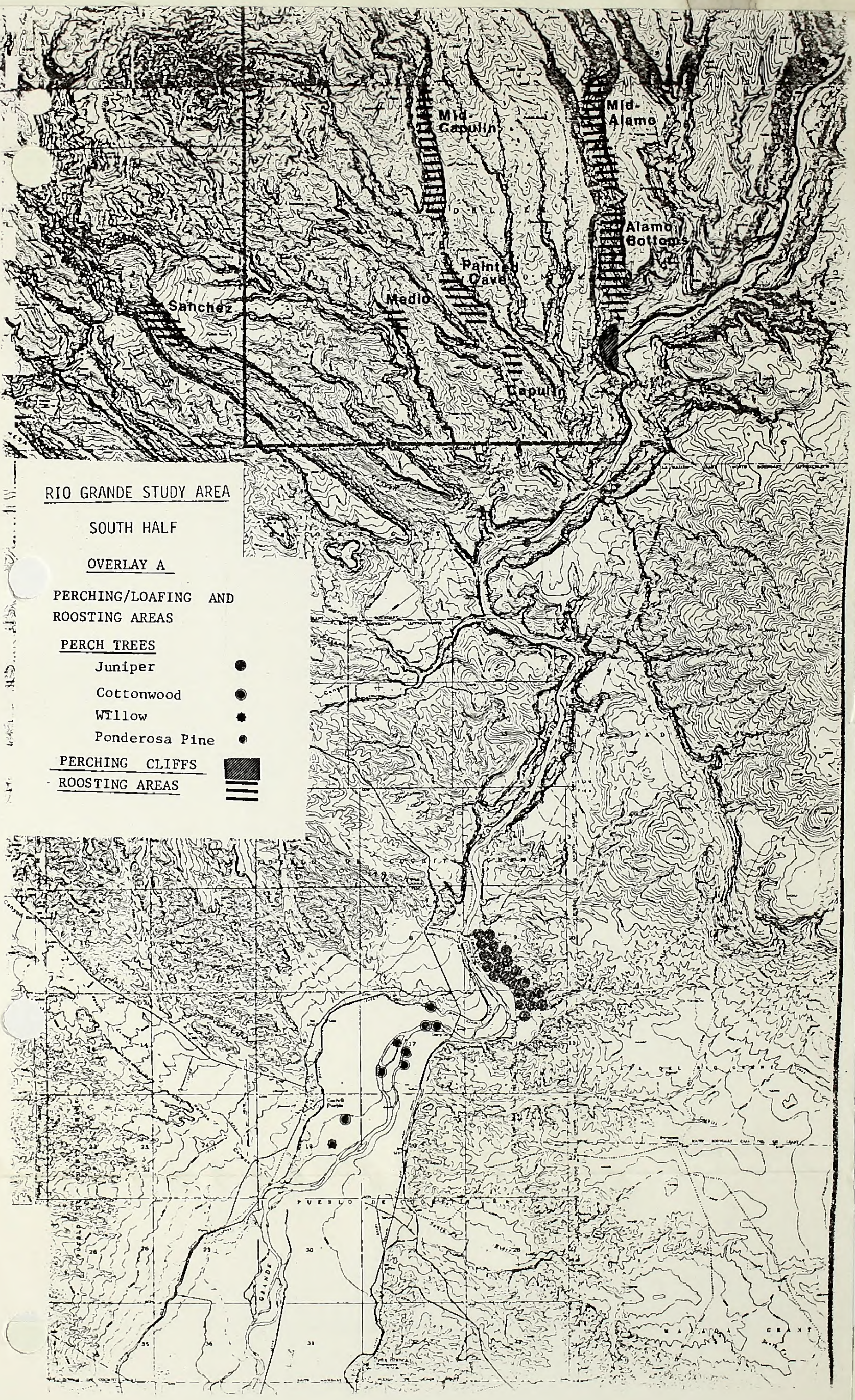
RELATIVE DEGREE OF
BALD EAGLE HABITAT USE

High Use
Moderate Use
Low Use

PERCHING/LOAFING AND
ROOSTING AREAS

Perch Trees

Juniper
Cottonwood
Willow
Ponderosa Pine



RIO GRANDE STUDY AREA

SOUTH HALF

OVERLAY A

PERCHING/LOAFING AND ROOSTING AREAS

PERCH TREES

- Juniper ●
- Cottonwood ●
- Willow ✸
- Ponderosa Pine ●

PERCHING CLIFFS

ROOSTING AREAS

RIO GRANDE STUDY AREA

SOUTH HALF

OVERLAY B

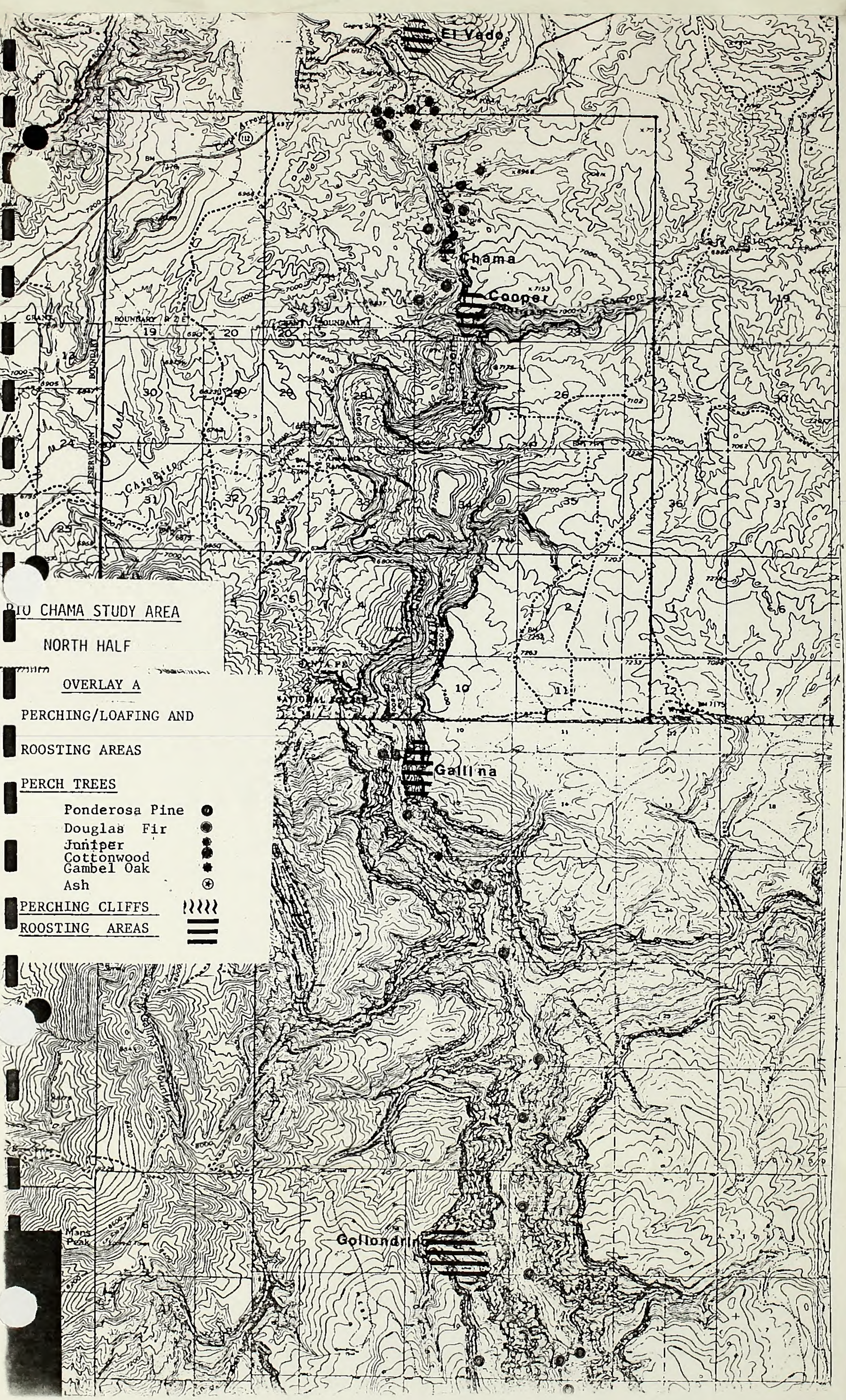
RELATIVE DEGREE OF
BALD EAGLE HABITAT USE

High Use
Moderate Use
Low Use

Appendix C. Map (north and south halves) of Rio Chama study area showing habitat utilization areas. Both maps have two overlays, A and B.

Overlay A. Perching/loafing and roosting areas.

Overlay B. Relative degree of bald eagle habitat usage.


RIO CHAMA STUDY AREA
NORTH HALF
OVERLAY A
PERCHING/LOAFING AND
ROOSTING AREAS
PERCH TREES
Ponderosa Pine
Douglas Fir
Juniper
Cottonwood
Gambel Oak
Ash
PERCHING CLIFFS
ROOSTING AREAS
El Vado
Chama
Cooper
Gallina
Gollondrina
GRANT BOUNDARY
BOUNDARY
RESERVATION
NATIONAL FOREST

RIO CHAMA STUDY AREA

NORTH HALF

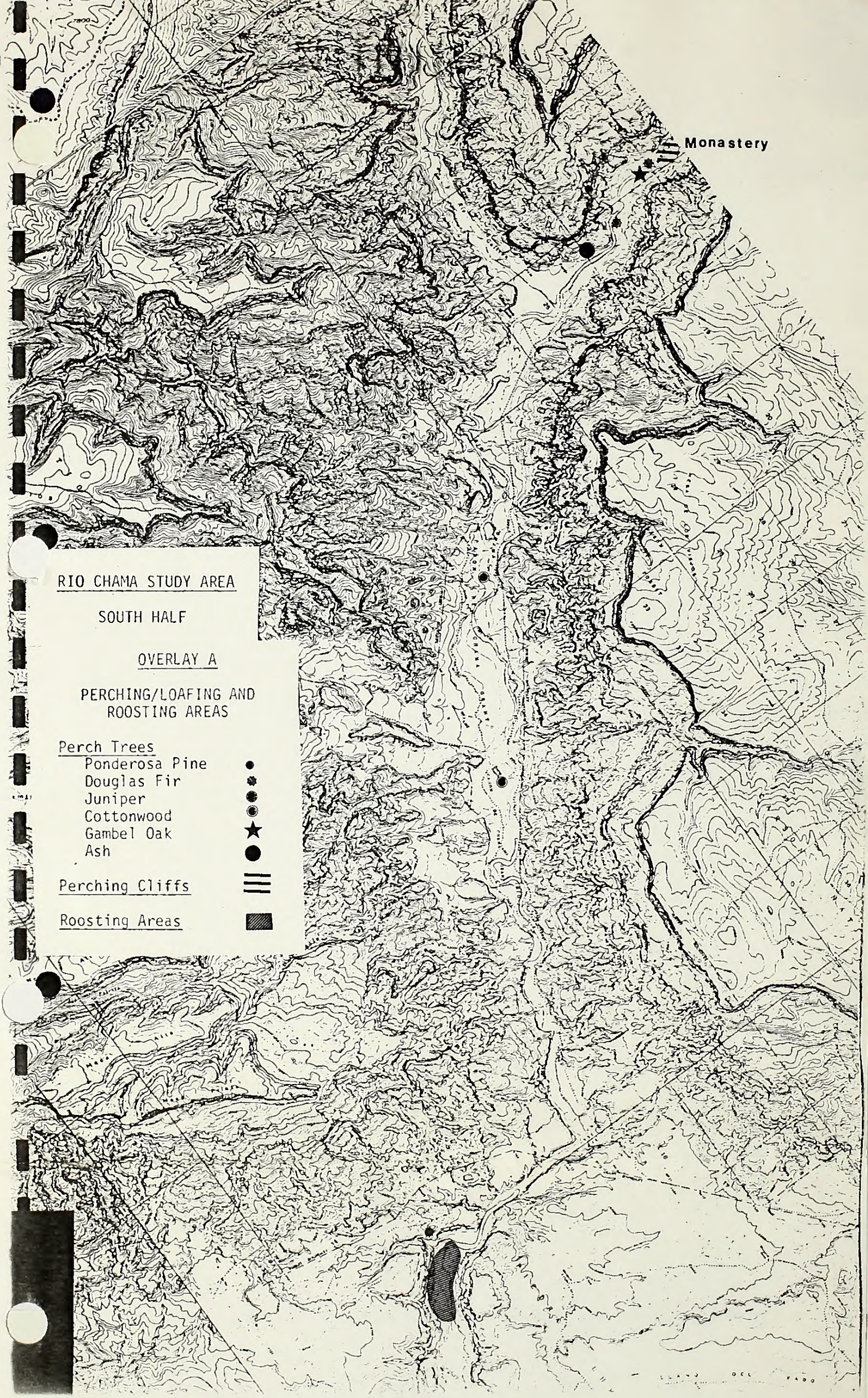
OVERLAY B

RELATIVE DEGREE OF
BALD EAGLE HABITAT USAGE

High Use

Moderate Use

Low Use



RIO CHAMA STUDY AREA

SOUTH HALF

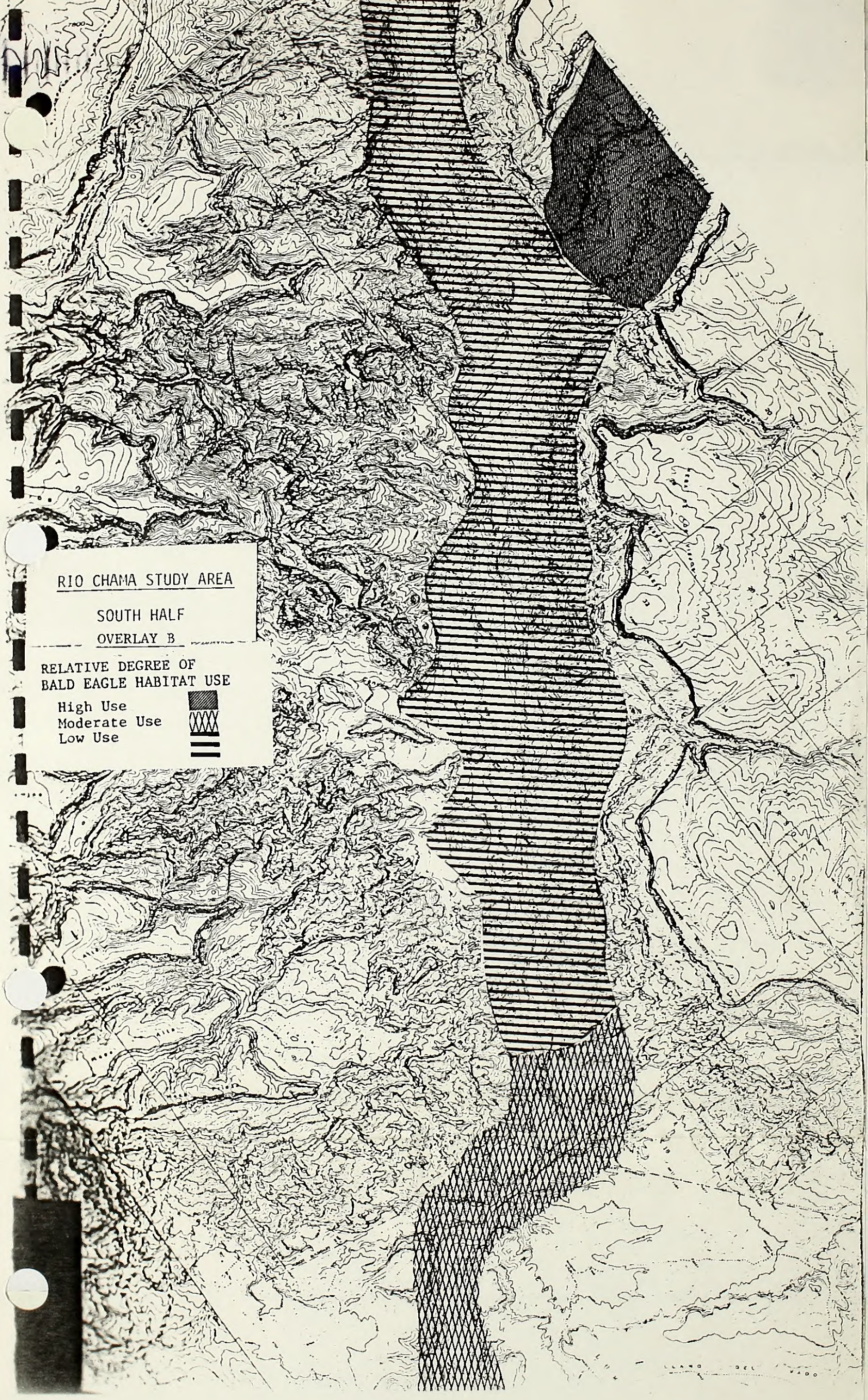
OVERLAY A

PERCHING/LOAFING AND
ROOSTING AREAS

Perch Trees
- Ponderosa Pine
- Douglas Fir
- Juniper
- Cottonwood
- Gambel Oak
- Ash

Perching Cliffs

Roosting Areas


RIO CHAMA STUDY AREA
SOUTH HALF
OVERLAY B
RELATIVE DEGREE OF
BALD EAGLE HABITAT USE
High Use
Moderate Use
Low Use

GILA Riv

WINTERING AND NESTING BALD EAGLES IN THE GILA NATIONAL FOREST: THEIR ECOLOGY AND HABITAT REQUIREMENTS

PREPARED FOR

THE UNITED STATES FOREST SERVICE
GILA NATIONAL FOREST
SILVER CITY, NEW MEXICO
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27 AUGUST, 1979

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APPENDIX 6 MAP OF ROOST GROVES SEVEN MILES SOUTH OF CLIFF
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INTRODUCTION

During January, February and March, 1979, we studied bald eagle (Haliaeetus leucocephalus) biology and habitat requirements in selected portions of the Gila National Forest. During March and April, in addition to making observations on wintering eagles, we searched for evidence of nesting attempts by bald eagles. We learned of a currently nesting pair, and made some observations on the behavior of this pair.

This work was performed under contract number 43-8399-9-170 for the Gila National Forest, Silver City, New Mexico. The Gila National Forest's goals, as presented in the Request for Quotations, and our study plan, submitted in response to that request, are presented in Appendices 1 and 2. An interim report was submitted to the Gila National Forest on 28 February, 1979.

Field work was accomplished by means of three teams of two researchers each. The time spent in the field was allocated in this fashion: Gary Falxa and Dirk Lanning, 1-31 January; Devora Ukrain and David Whitacre, 1-28 February; Kate and Roger Skaggs, 6-31 March and 11-14 April.

We flew low level reconnaissance flights in search of bald eagles on 8 February and 26 March.

STUDY AREAS

Initially, our plan was to focus intensively on only four study sites: two lakes and two river segments. In part, this arrangement was chosen to facilitate comparisons of eagle use of riparian and lacustrine environments. On Bruce Anderson's suggestion and on the basis of results of a 1978 bald eagle survey of the Gila N. F. (Gast, Hunt, Garcelon and Hanna 1978),

we chose Snow Lake and Centerfire Bog as the two lacustrine study areas, and the East Fork of the Gila River and Negrito Creek as the two riparian areas.

We did use all of these areas as our intensive study sites, visiting them during each of the three months of study, with the exception that a heavy snowpack made a February or March visit to Snow Lake impractical and pointless, as there was evidence that no eagles were using the frozen and snow-covered lake. We did visit Snow Lake in January and in April.

In addition to these intensive study sites, we were rewarded with the opportunity to study an aggregation of 11 bald eagles feeding upon and roosting near a hog (Sus scrofa) carcass along the Gila River below Cliff. As this was an unusual opportunity to observe bald eagle social interactions and feeding, perching and roosting behavior and habitat, we added this site to our list of intensive study areas, and spent several days here in February. Also, in our studies of the upper reaches of the East Fork of the Gila River, we visited Wall Lake enough to consider it an intensive lacustrine study site.

We also made observations as opportunity arose, at other areas, including Lake Roberts and Luna Lake. Where applicable, results from these incidental areas are included in discussions, as, for example in the discussion of seasonal and inter-habitat variations in eagle numbers and age structure.

METHODS

We used binoculars and spotting scopes to find and observe bald eagles, mainly while searching the study areas described above, and other riparian and lakeshore areas in the Gila National Forest.

Nearly all of the river and stream segments surveyed were, necessarily, travelled on foot. We made day hikes and two or three day backpacking trips, travelling up to 14 miles from our vehicle. We wore hip waders for use in the frequent creek crossings, and brought hiking boots as well on the two and three day trips, for use on long stretches without crossings and for camp wear. Though we usually hiked along the stream banks, we found that the more time-consuming tactic of hiking across the open grama benches and juniper-oak woodlands above the canyon rims was also rewarding. It perhaps afforded more sightings of soaring eagles, and sometimes permitted us to spot eagles perched along the watercourses before the eagles spotted us and flushed.

We noted eagle sightings on U. S. Geological Survey topographic maps, using a number or letter which cross-referenched to detailed notes on perches, habitat and behavior, and/or a standardized sighting/perch report form (see Appendix 3). We took 35 mm color transparencies of many perch sites and selected habitat examples.

We made every effort to avoid disturbing eagles once we had sighted them, in the hope that we could watch them and learn something about their diet and foraging behavior. This tactic met with limited success (see page 26).

Height and diameter at breast height (dbh) of perch trees, and diameter of perch limbs were estimated, sometimes from a distance, with the exception of the roost groves south of Cliff, in which all measurements except height were made with a tape or ruler.

Each month's eagle sightings for each of the eight study areas (including Luna Lake and Lake Roberts) were analyzed in order to estimate the minimum and most probable bald eagle population of each area for that month. These population estimates are based on 1) the minimum number of distinct individuals recognizable by plumage (age) differences, and plumage irregularities (e.g., broken feathers), 2) num-

bers of eagles seen simultaneously, and 3) patterns of eagle fidelity to certain areas. There is probably a tendency to underestimate the number of adults as compared to the number of immatures, because, after six years of age, adults can not be separated into year classes, whereas eagles up to six years of age can be recognized by year class. As a result, more immatures are individually distinguishable from their neighbors than are adults. Thus, observations naturally tend to overemphasize the presence of immatures in relation to adults.

We collected some additional information about bald eagle occurence, food habits and reported nestings by speaking with local residents and from sighting report records of U. S. F. S. personnel, maintained by Bruce Anderson.

In a few cases, we left self-addressed post cards with ranchers, for their use in mailing us data on bald eagle sightings. This provided a few very interesting items of information.

BIOLOGY OF BALD EAGLES WINTERING IN THE GILA NATIONAL FOREST

Numbers and Age Ratios of Bald Eagles in Eight Study Areas, January through March

Table 1 presents the minimum and estimated numbers and ages of bald eagles using eight survey areas during January, February and March, 1979. The estimated number of eagles using these areas rose from 14 in January to 40 in February, and dropped to 24 in March (Fig. 1). The number of adults was nearly constant through the three month period (11, 14 and 13 adults, respectively). This was not true of immatures. The majority of eagle population changes apparently were due to movements of immature eagles into and out of the area.

	Immatures / Adults		
Area	Jan.	Feb.	Mar.
Centerfire Bog	0/2	--	1/2
Negrito Creek	1/3	6/4	3/2
Snow Lake	1/4	0	0
Upper East Fork of Gila and Wall Lake	--	2/4	1/3
Lower East Fork, Gila	1/2	5/3	4/5
Lake Roberts	--	0/1	--
Luna Lake	--	--	2/1
Gila River below Cliff	--	13/2	--
Totals	3/11	26/14	11/13
Immature/Adult Ratio	(0.027)	(1.857)	(0.846)

TABLE 1. ESTIMATED NUMBERS AND AGE RATIOS OF BALD EAGLES USING EIGHT STUDY AREAS DURING JANUARY, FEBRUARY AND MARCH, 1979.

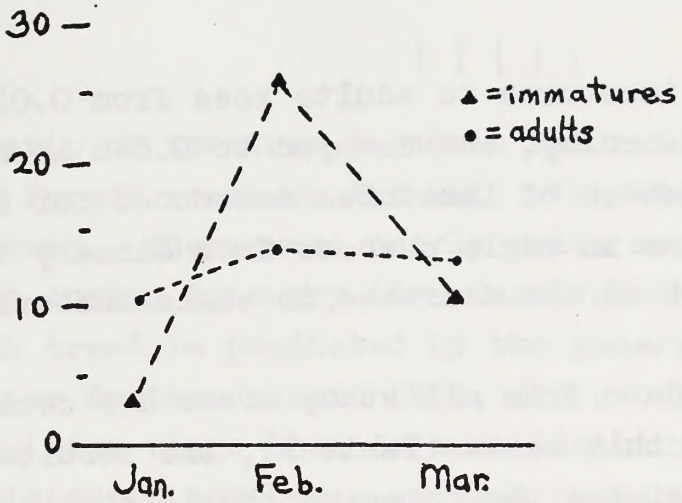

FIGURE 1. CHANGES IN ESTIMATED TOTAL NUMBERS OF IMMATURE AND ADULT BALD EAGLES IN EIGHT STUDY AREAS DURING THREE MONTHS.

October	21	February	104
November	38	March	42
December	77	April	8
January	82		

TABLE 2. TOTAL MONTHLY WINTER BALD EAGLE SIGHTINGS IN ARIZONA OVER A FIVE--YEAR PERIOD (Table VI, p. 166, Todd 1978).

	Lakes	Rivers and Streams
Immatures	4	36
Adults	10	28
Immature / Adult Ratio	0.4	1.286

TABLE 3. RATIOS OF IMMATURE AND ADULT BALD EAGLES USING RIPARIAN AND LACUSTRINE HABITATS. *See page 9 of text for explanation of how study areas are grouped under these two habitat types.

The ratio of immatures to adults rose from 0.027 in January to 1.857 in February, and dropped to 0.846 in March (Table 1). Changes in numbers of immatures accounted for 88.5 percent of the increase in eagle numbers from January to February, and 94 percent of the decrease in eagle numbers from February to March.

When data from all study areas are combined and compared on a monthly basis (Table 1), the resultant age ratio differences between the three months is statistically almost significant ($.10>p>.05$; Chi Square value = 8.293, 4 degrees freedom).

Apparently, the yearly influx of bald eagles into the Gila National Forest reached a peak in February. The departure, at least of immatures, was well under way in March when eagle numbers were still higher than in January. The data (Fig. 1) suggest that adults arrived earlier than most immatures, and perhaps remained in the area later in the spring. More years of data would be needed to definitely establish this as fact. Censuses during October, November and December would be necessary to document the arrival period.

The suggested pattern of early adult arrival and departure does fit well with information available on winter bald eagle movements in the western states. In Utah and Washington, adults arrive on the wintering grounds before immatures, and adults leave Utah before immatures in the spring (Edwards 1969: 48; Servheen 1975: 37; Stalmaster 1976: 28; all in Steenhof 1978).

Immature bald eagles apparently winter farther south on the average than do adults (Sprunt and Cunningham 1962; Ingram 1965; Sprunt and Ligas 1966; all in Steenhof 1978). Thus, in the northern states (i.e. Wisconsin, Illinois, Idaho and South Dakota), wintering adults outnumber immatures, while the reverse is true in the more southern states Missouri and Oklahoma (Ingram 1965; Southern 1964 and 1974; Lint 1975; Grewe 1966: 13; Steenhof 1976: 61; Halloran 1959; all in

Steenhof 1978).

The ratio of immature to adult bald eagles in the Gila National Forest seems to fit well with the above-mentioned pattern. There were nearly twice as many immatures as adults seen during February (immatures/adults = 1.857, Fig. 1), which trend is predicted by the generalization that immatures winter farther toward this, the southern fringe of the species' winter range than do most adults.

The timing of occurence of peak numbers of wintering bald eagles seems to vary considerably between local areas in the southwestern states. In general, eagles are present in southwestern areas from November through March (Steenhof 1978), though some are present in Arizona in October and April as well (Todd 1978). In southeastern Colorado during two winters, numbers were highest in December and early January, with few observations after mid-February (Anderson and Craig 1974, in Todd 1978). A one-winter survey in "the southern Rocky Mountains" found highest bald eagle numbers in January and February (Boeker 1972 ?, in Todd 1978). One northern Utah wildlife refuge reports peak eagle numbers in January, while two others report peak numbers in March (Todd 1978). In a compilation of five years of eagle sightings in Arizona, Todd (1978: p. 16b), found wintering eagles present from October through April, with greatest numbers during December through February, and the highest peak in February.

Though far more data are needed before a definitive statement can be made, our results suggest a February peak in bald eagle numbers in the Gila.

Differential Habitat Choice by Adult and Immature Bald Eagles

Not only did the proportions of adult and immature

eagles vary in time, but they were different in the various study areas. When lake habitats (Snow Lake, Centerfire Bog, Lake Rober s and Luna Lake) are compared with river and stream habitats (Negrito Creek, Gila River below Cliff, East Fork of the Gila River, and Wall Lake *, Beaver, Taylor and Hoyt Creeks), the immature to adult ratio is higher in the riparian than in the lacustrine group (Table 3). That is, proportionally more immatures and/or fewer adults were seen in river than in lake habitats. This difference is statistically significant ($p<.05$; Chi Square value = 3.96; 1 degree freedom).

We also noted a tendency toward larger immature to adult ratios in lower portions of drainages compared to headwater areas. If Negrito Creek and the upper East Fork of the Gila River, Wall Lake and Beaver, Taylor and Hoyt Creeks are considered headwater areas, and compared to the lower East Fork of the Gila (mid-drainage) and the Gila River below Cliff (lower drainage), the resultant immature to adult ratios are 0.812, 1.0 and 6.5. Though suggestive, these differences are not statistically significant (Chi Square value = 7.495; 4 degrees freedom).

This phenomenon of differential habitat use by young and adult bald eagles would be among the most interesting topics for further winter eagle studies in the Gila National Forest. A couple of speculations may be advanced in an attempt to explain the observed patterns. In Washington, more immature than adult eagles use river systems, where food is reportedly more abundant (Stalmaster 1976: 36; in Steenhof 1978). This could be the case in the Gila National Forest as well. Clearly, the pattern reported here was largely a result of a group of 10 immatures and one adult which fed at

---

* Wall Lake was included in the riparian class because it is surrounded by riparian areas (Beaver, Hoyt and Taylor Creeks and East Fork of Gila River) and because eagles moved freely between Wall Lake and these riparian areas.

a hog carcass on the main Gila River below Cliff for at least seven days. In this case, the riparian habitat provided a food resource which was utilized much more heavily by immature eagles than by adults.

The tendency for adults to be relatively more abundant in headwater areas than in lower portions of drainages may be a result of their great wariness and intolerance of human activity. As mentioned elsewhere, we repeatedly noticed that immature eagles permitted closer approach by humans before flushing than did adults. Headwater areas are, by their nature, often more insulated from human disturbance than are many lower river segments. This idea, however, does not seem to apply very well to the specific areas we studied. The portion of the Gila River below Cliff, where 11 eagles fed on a hog carcass, actually seems to receive less human use than the headwater-type habitat along Negrito Creek immediately below the Kiehne Ranch, where bald eagle concentration occurred.

A further speculation would be that perhaps food habits of adult and young bald eagles in the Gila differ, resulting in differential habitat use(see Food Habits).

Food Habits

Bald eagles are well known to be opportunistic feeders, consuming a wide variety of prey species which they catch alive, find as carrion, or pirate from other predators. Although in many situations they feed nearly exclusively on living or dead fish, they also may depend heavily on disabled or dead waterfowl and carcasses of small or large game mammals and livestock. Many wildlife biologists share an impression that an unexpectedly large number of wintering bald eagles are thinly scattered over western rangelands where

they rely on wildlife and livestock carrion and small mammals for food (Spencer 1976, Snow 1973).

During the week 5 through 11 February, 1979, up to 11 bald eagles fed daily on a hog carcass along the Gila River seven miles south of Cliff, New Mexico (SE 1/4, NW 1/4, Sec. 3, T 7 S, R 17 W, see photo no. 4). More details about the area and eagle behavior at the carcass may be found on pages 14 and 30. All or most of these 11 eagles (10 immatures, 1 adult) roosted each night in a grove near the carcass (photo no. 5). It was our impression that each of these eagles was deriving its total sustenance from this carcass at least during 5, 6 and 7 February when our observations were extensive. Judging by the amount of the carcass already consumed when we discovered it on 5 February, and its subsequent rate of disappearance, we feel it is likely that an equal number of eagles had been feeding on it for about three days when we discovered it. At least some of the eagles were still feeding on it on 11 February, but the bones had been picked clean by the morning of 12 February, when no eagles or ravens (Corvus corax) visited the remains.

This hog carcass, which we estimated to have weighed 100 to 170 pounds on the hoof, provided at least 33, and perhaps more than 100 eagle-days of food, plus a large number of raven-days of food, since about 40 common ravens also fed on the carcass daily throughout this time span.

On 9 January, Falxa and Lanning found strong evidence that one or more bald eagles had been feeding on a deer (Odocoileus sp.) carcass along Negrito Creek. A fifth-year eagle and four ravens were seen near the carcass, which was freshly picked clean and scattered over the creek bank, accompanied by many large avian mutes on the ground and under nearby trees. Some portions of the deer had evidently been carried up into nearby trees and consumed there.

There is some slight suggestion that bald eagles may have fed on carrion at Wall Lake. In a garbage ditch 150-200

feet southwest of the lake (about 150 feet from the most-used bald eagle perch tree) we found, on 18 February, the denuded carcasses of at least one canid (presumably a coyote (Canis latrans)) and one smaller carnivore. These entire skeletons, though fairly fresh, had evidently been picked clean by some scavenger(s). Some meat remained in hard-to-reach areas, suggesting to us that vertebrate scavengers, rather than maggots or other arthropods, had done most of the cleaning. However, there is no direct evidence that bald eagles had fed on these carcasses.

Similarly, remains of a wild turkey (Meleagris gallopavo) and a cinnamon teal (Anas cyanoptera) found at Centerfire Bog on 31 March and 1 April may well have been bald eagle kills, but there was no direct evidence of this.

In three cases we watched bald eagles peer intently for several minutes down at watercourses above which they were perched, probably looking for fish or other aquatic prey. These instances involved a four year old on 14 February along the East Fork of the Gila River, an adult on 19 February, also along the East Fork, and an adult on 16 March, along Negrito Creek. We did not witness attempts by these or any other eagles to catch prey.

On 13 and 24 March, Roger and Kate Skaggs found two trees which evidently had been heavily used by perching and/or roosting eagles. The ground beneath both trees was spattered with whitewash, and several large pellets (castings) were found. These pellets (10-12 in number) contained fish vertebrae and scales, feathers, bones of a robin-sized bird, a jaw of a mouse-sized rodent, and about four kinds of fur, including probable small rodent and deer hair. A partially eaten frog (Ranidae) was also present. It is impossible to entirely rule out the possibility that these castings were made by great blue herons (Ardea herodias) rather than bald eagles. We did not, however, see any herons in our many person-days spent hiking along the East Fork. By the same

token, we never saw golden eagles (Aquila chrysaetos) perch in trees in river bottoms, so it seems unlikely that the pellets were made by golden eagles. Thus, we feel justified in considering these remains to be valid bald eagle dietary information. Unfortunately, the identity of the pellet contents tell us very little about the feeding ecology of bald eagles in the Gila, since we don't know if the prey was captured alive or taken as carrion.

In addition to these findings of our own, we present here four relevant sightings referred to us by Bruce Anderson, Forest Biologist, Gila National Forest, contained in his monthly bald eagle sighting report summaries, one observation reported to us by D. Hunt and some observations reported by Jess Brennand, a rancher and long-time occupant of Negrito Creek.

On 11 December, 1978, E. Paul and E. Nichols saw two adult bald eagles feeding on a dead steer north of Apache Creek* (Anderson 1979). During the winter of 1977-78, B. Ferguson saw two adults feeding on a deer carcass near Spur Lake (Ibid.). Dustin Hunt saw four adult bald eagles and two golden eagles feeding on a pile of elk (Cervus canadensis) guts on Rainy Mesa on 14 March, 1979 (Dustin Hunt, Pers. Comm.). On 1 December, 1978, E. Alfred and M. Winters saw an adult and an immature bald eagle chasing mallards (Anas platyrhynchos) at Wall Lake (Anderson 1979). On 21 November, 1978, B. Ferguson saw an adult chasing a duck at the newly-developed Steel Flat wetland (Anderson 1979). Very early one morning during the winter of 1977-78, Kate and Roger Skaggs saw an adult bald eagle fishing in the Gila River near Turkey Creek (Skaggs and Skaggs 1978). Jess Brennand of Negrito Creek states that he has seen a bald eagle catch a great blue heron and has seen one feed on a stillborn calf (see page 51).

*Precise locations are given in Anderson 1979.

In summary, we scarcely have enough quantitative data to make an educated guess about the relative proportions of live fish and small game as compared to livestock and big game carrion in the diet of wintering bald eagles in the Gila National Forest. Omitting the questionable coyote case at Wall Lake and the prey remains and pellet contents from below the two roost/perch trees, we are left with seven cases of eagles chasing ducks, catching a heron and probably fishing, and six cases of eagles feeding on large game and livestock carrion. This may suggest that cases of foraging for living aquatic prey and carrion feeding occur with about equal frequency. On the other hand, the tremendous amount of eagle feeding observed at a single hog carcass suggests that large game and livestock carrion may be a vital food source to wintering Gila National Forest eagles. This idea is perhaps supported by our frequent observations of eagles soaring far and wide over rangeland when lift conditions were favorable (see page 22).

Behavior of Bald Eagles Feeding on a Carcass

We observed feeding, perching and other behavior of up to 11 bald eagles that frequented the vicinity of a hog carcass along the Gila River 5 through 12 February (see photo no. 4). On 5, 6, 7 and 10 February, we observed eagles feeding on this carcass; their behavior permitted the following generalizations.

Bald eagles fed upon the carcass most actively during the morning and mid-day. No feeding was noted in late afternoon of 5 February after we discovered the carcass. Feeding was still in progress during our latest observations (1300) on 6 February.

Usually, not more than one eagle fed on the carcass

at a given time. Though a second eagle was often allowed to pace around the carcass, tugging at an extremity from time to time, a closer approach generally resulted in a brief altercation, in which both eagles pranced around, facing one another with wings outstretched. One or the other would quickly move off. We were too far away to hear any vocalizations which might have been voiced during such encounters. There was often a "backlog" of two or three eagles waiting on the ground or on driftwood within 50 feet of the carcass. When one eagle finished eating and flew away, another would take its place within 20 seconds. Sometimes, a succession of displacements occurred before a third or fourth eagle would be allowed to begin feeding. While not engaged in feeding, eagles frequently pecked at or picked up in their talons bits of flotsam and sticks. At least once, two eagles grasped the same stick in their talons, and briefly danced around with wings spread, before one relinquished his end of the stick.

Interactions of Bald Eagles with Other Bird Species

A contingent of an estimated 40 common ravens was present in the same short stretch of river as the eagles seven miles below Cliff. They too fed heavily on the hog carcass. Ravens were nearly always present at the carcass during daylight hours, often in a group of ten to twenty. When an eagle was feeding, the ravens usually remained on the fringes, merely tugging now and then at the edges of the carcass. When no eagle was feeding, the ravens crowded over the carcass.

Though a raven pursued a melanistic red-tailed hawk (Buteo jamaicensis), stooping repeatedly at it, ravens did not attack bald eagles in this manner. Up to five or ten

ravens sometimes followed flying eagles, or landed near perched eagles, but we did not observe active harassment.

We occasionally saw bald and golden eagles in proximity along the East Fork of the Gila River and Negrito Creek. At Negrito Creek, two or three golden eagles soared in the same area with up to three bald eagles for about one hour; we witnessed no interactions between the two species at this time. We have noticed that golden eagles usually perch in trees or snags high up on mountain sides or tops. Though bald eagles usually perched lower down near stream courses, they used some mountain rim perches along Negrito Creek (see photo no. 15), so that the probability of competition with golden eagles for perch sites is perhaps more likely here than in the other study areas. It would seem trivial in importance, however, because potential perches seem innumerable here. Golden eagles characteristically soared in presumed hunting flight, very low over mountain flanks, often between rather than over the treetops. We made no observations of feeding or pursuit of prey by golden eagles. They do feed on carrion (Pers. Obs.) as do bald eagles, so there would seem to be the possibility for food competition over carrion. It would be interesting to know how golden and bald eagles interact at a carcass that is discovered by both species, as for instance, that reported by Dustin Hunt (page 13).

On 31 March at Centerfire Bog, an immature golden eagle followed one of the nesting bald eagles closely, then perched near it in the same tree. It then flew and made two stoops at the adult bald eagle. At this point, the other bald eagle, probably the male, left its incubation duty on the nest to chase the golden eagle, in which it was joined by its harried mate. Shea (1973) states that bald eagles at salmon concentrations in Glacier National Park fear golden eagles; the arrival of an immature golden caused many bald eagles to fly away. The bald eagles became more accustomed to the golden eagle's presence as the season progressed.

The nesting bald eagles at Centerfire Bog were also attacked repeatedly by an adult red-tailed hawk on 31 March and 1 April. A pair of red-tails frequented the area, so it is likely that this buteo was defending a nesting territory.

Aggressive Interactions Between Bald Eagles

As described on page 15, pairs of bald eagles sometimes "sparred" briefly over eating privileges at a carcass. A very few instances were noted in which a perched eagle was displaced, or forced to vacate its perch, by another eagle which preempted the perch. Usually, eagles perched within a few feet of one another without strife. On a few occasions while small groups of eagles were soaring together, one would stoop on, or follow very closely, turn for turn, another eagle, which would try to evade its pursuer, though usually without much expenditure of flight energy. Immature eagles chased an adult, a fifth-year eagle, and another immature, and the five year old just mentioned turned the tables on its aggressor. In no case did either bird in such encounters have prey, so piracy apparently was not an object in these chases. These aerial maneuvers were identical to ones commonly observed by Lish (1973) in bald eagles wintering in Oklahoma, and described by him as "talon presenting" and "tail chasing" behavior.

On one occasion, two adult eagles engaged in similar behavior intently for about fifteen minutes. It is possible that this was courtship behavior (see page 18); subsequent checks of the area did not reveal a nesting pair, however.

In general, bald eagles behaved gregariously in their perching, roosting (especially) and soaring. They did not appear to defend any area against conspecifics, except perhaps an "individual distance" while perched, and perhaps

favorite perches and temporary feeding space.

Possible Bald Eagle Courtship Behavior Along Upper East Fork of Gila River

In mid-afternoon of 18 February, we saw three adult bald eagles soaring over the East Fork of the Gila River at the mouth of Beaver Creek. Two of these eagles engaged for about 15 minutes in what may have been courtship activity. One eagle stooped repeatedly (often shallowly, or in a mere dip) at the other, which invariably rolled upside down, often completing a full roll. Between stoops, the "aggressor" followed close above and behind the "victim", turn for turn, in neat formation. The fact that neither eagle flapped its wings throughout the episode suggested to us that this was not a truly aggressive or territorial encounter; if such had been the case, we would have expected to see the "victim" exert itself to escape from its tormentor.

On 3 April, at the same location, Ron Warren (Pers. Comm.) observed what he thought to be bald eagle mating or courtship, stating that "it was the best show I have ever seen." We feel it is likely Ron observed behavior similar to that described above.

Lish (1973) describes "talon presenting" and "tail chasing" behavior in wintering bald eagles in Oklahoma, which seem identical to the behaviors described above and under Aggressive Interactions Between Bald Eagles. As in our observations, his talon presenting observations did not include physical contact in the form of talon locking and a whirling fall, which characterize bald eagle courtship (Retfalvi 1965). Perhaps significantly, however, in 28 observations, Lish never saw an adult tail chase another adult, as was the case

in the Beaver Creek incident described above.

In summary, this observation did not include talon locking behavior which is characteristic of classic bald eagle courtship, but it was not completely typical of normal interactions between wintering eagles either. We suggest that it may have been early courtship behavior.

Diurnal Perches

Bald eagles typically perch in and hunt from prominent trees that afford a good vista of the surrounding area. They are also known to perch on other structures such as rock outcrops, logs, driftwood, ice, the ground, haystacks, powerline poles and fenceposts (Steenhof 1978). During this study, the only place we saw eagles use non-tree perches was at the hog carcass feeding site, where they used driftwood, logs, mounds of flotsam, the bare ground, and often waded in the river. In one other case along the East Fork of the Gila River, an eagle may have been perched on the ground or low driftwood. The remaining perches were all trees.

Of the 51 diurnal perch trees on which we recorded data, 55 percent were ponderosa pines (Pinus ponderosa), 39 percent were cottonwoods (Populus spp.), 2 percent were Gambel oaks (Quercus gambelii), 2 percent were hawthornes (Crataegus sp.), and 2 percent were hackberries (Celtis sp.). The height of perch trees ranged from 25 to 75 feet, with a mean of 51 feet (S.D. = 13 feet, N = 42). Diameter at breast height ranged from 15 to 60 inches, with a mean of 34 inches (S.D. = 30 inches, N = 13). We classified the condition of the perch trees using the following categories (percent of trees in each class follows the description): 1) all dead, top intact--49 percent; 2) all dead, top broken-- 2 percent; 3) living, top broken--2 percent;

4) living, top dead but intact--5 percent; 5) all living, top intact--41 percent. In summary, living and dead trees with tops intact constituted 90 percent of the diurnal perches, exclusive of perches used around the hog carcass.

Bald eagles prefer to perch in trees with stout, fairly horizontal, open branches in the upper section of the crown. The perch limb must be uncluttered by twigs and small branches, allowing the eagle access without hitting obstructions with its wings. Eagles perched in the upper third of the tree in 73 percent of our sightings, the middle third in 27 percent, and were never seen to perch in the lower third of a tree. They showed a tendency to perch toward the outer end of limbs; the outer third was used 47 percent of the time, the middle third 38 percent and the inner third 15 percent of the time.

Diurnal perches were usually occupied by one eagle at a time, though two large dead trees near the hog carcass had up to 3 bald eagles perched in them at times (photo no. 1). These trees had very open crowns, with few limbs, which were stout and many were horizontal. In the same area, a downed log with a few protruding limbs on a gravel bar, was a popular perching spot, often attended by 3 or 4 eagles at a time.

The riparian vegetation community was very important in providing bald eagle perches. Sixty seven percent of the perch trees used by eagles along rivers were in the river bottom or floodplain. The remaining 33 percent were on hillsides. Some areas, such as Negrito Creek, had a higher percent of perches on steep hillsides, probably due to the narrowness of this canyon and the limited extent of the riparian habitat. In this case, ponderosa pines, both living and dead, were important perches.

Roosts

We located seven roosting trees or areas during our field work. Three roost trees were found along Negrito Creek, one at Centerfire Bog, one along the lower East Fork of the Gila River, one along Beaver Creek, and a large communal roost area along the Gila River seven miles below Cliff. These roosts will be discussed individually in the Study Area Accounts section.

Bald Eagles roost both communally and singly during the winter (Steenhof 1978). Eagles often leave winter roosts at or before dawn. Inclement weather or poor hunting success may draw eagles back into the roost area as early as 1100, or, in very stormy weather, they may not leave the roost at all (Cooksey 1962; Ingram 1965; Shea 1973; Lish and Lewis 1975; in Steenhof 1978). We observed eagles still in the communal roost as late as 1012 on a sunny day. In this case, the two eagles may have already left the roost grove and returned to perch in it. On 10 February at 1553 we counted 9 eagles perched in several cottonwoods that comprised the communal roost, presumably settled in for the night. In general, a slow movement of eagles into the roost grove began in late afternoon, and continued up to darkness, when the last few eagles arrived.

The branches chosen for roosting were usually nearly horizontal, near the top of the tree, dead or with few twigs, and provided a good view.

Steenhof (1978) points out that roost trees do not need to be in close proximity to water. All of the riverine roosts that we found or inferred were within about 200 feet of the watercourse. The one lacustrine roost we located was one half mile from the lake.

We do not have any information on whether or not the same individual used the same roost tree repeatedly, but

most or all of the eagles using the communal roost below Cliff were the same individuals from day to day. It is well known that bald eagles often use the same winter roost areas year after year. Thus, the known and inferred roosts documented here deserve protection from habitat destruction and excessive human disturbance.

Soaring Flights

We noted a tendency of eagles to embark on long, far-ranging soaring flights during the late morning and mid-day hours. At such times, up to three or four eagles, of all ages, often soared in a loose group, moving slowly over distances of a few to several miles, circling above all kinds of habitats and topography, from riparian flats to grama (Bouteloua spp) benches and oak, juniper, pinyon and ponderosa pine mountainsides. These forays seemed to be restricted to times when soaring conditions were favorable, i. e., lift was provided by thermals and/or slope currents created by wind hitting mountain slopes. Though we have no direct evidence that eagles were prospecting for carrion or living prey during these soaring forays, it seems likely.

Other researchers have noted that soaring usually occurs when wind velocities are from three to 15.5 mph, and especially, eight to 15.5 mph (Southern 1964; Jonen 1973:65; Steenhof 1976: 93, 1978). Furthermore, extended soaring is virtually confined to sunny days (Lish 1973). Platt (1976) found that bald eagles soared above canyon walls just before returning to the roost.

Effects of Floods on Bald Eagle Habitat

Recent severe flooding of the Gila River may have enhanced the quality of habitat along the river for wintering bald eagles. Seven miles south of Cliff, where eagles used a hog carcass and a cottonwood roost grove heavily, they spent most of the daylight hours perched on low driftwood or on the ground, amidst broad sandbars devoid of vegetation. Such low perches were not used elsewhere in the Gila N. F., and we feel sure that the absence of ground cover on the gravel bars and river banks facilitated this behavior. The ample scattering of driftwood, the broad sand and gravel bars, and the lack of ground cover over large areas, are all effects of recent flooding. Thus, flooding may have been beneficial to wintering bald eagles.

On the other hand, flooding knocks down large cottonwoods which are important eagle perch and roost trees. At the same time, flooding is said to create ideal conditions for establishment of new cottonwood seedlings (John Hubbard, Pers. Comm. to Roger Skaggs). Flooding may also create food sources for bald eagles, by drowning wild animals and livestock and by depositing animals killed in other ways where eagles can find them. Thus, the effects of flooding on bald eagles are complex and contradictory, but in an environment untrammeled by heavy human disturbance, flooding has no doubt, been a potent force in the evolution of such a riparian scavenger as the bald eagle. Without the detrimental effects of overgrazing upon riparian tree regeneration, and perhaps other human-induced environmental stresses, flooding is undoubtedly an acceptable, and probably, a beneficial part of the bald eagle's environment.

Effects of Weather and Water Turbidity on Bald Eagle Movements

Although one goal of this study was to investigate the relationship of bald eagle movements to weather patterns, our study plan and the realities of studying bald eagles in the rugged environs of the Gila N. F. did not permit the gathering of sufficient information to reach conclusions on this topic. A real effort to address this question should employ virtually daily eagle censuses of only one or two intensive study areas throughout the winter, as well as detailed meteorologic recordings. A few observations, however, are possible as a result of our studies.

Bald Eagles continued to frequent some lakes even when most of the water surface was frozen; however, at these times, we did not see evidence that the eagles were relying on these bodies of water for food. On 4 and 5 January, at least two adults utilized perches and a roost near Centerfire Bog, although the bog was completely frozen. On 8 February, when only two to five percent of the bog was open water, an adult was perched in a tree near the shore. No waterfowl were present on the former date, and probably none were present on the latter date either. On 6 January, when Snow Lake was 80-85 percent frozen and 60 waterfowl were present, 4 or 5 eagles were in the vicinity, though again, they were not seen to use the lake itself. On 8 February, Snow Lake was completely frozen and snow-covered, and no eagles were visible during several low-level airplane passes. Thus, it seems possible that bald eagles forsook Snow Lake during the height of the winter. However, since they were not really using the lake itself even when they were present there in January, an aerial search might not reveal eagles that are scattered in the vicinity, especially if they are mainly using the area for roosting. If the U. S. F. S. seeks more definitive information on

eagle use of Snow Lake during mid-winter, we suggest making 1) several aerial searches of the area and/or 2) a few strategically timed visits via skiis or sno-cat.

All of the river and stream segments used by eagles were used steadily throughout the study duration. There were no major stretches where we saw eagles during one visit and saw none on another visit.

On 8 February, D. Whitacre flew with Bruce Anderson and Gary Helbing on a four hour bald eagle survey of several Gila N. F. drainages and lakes. We saw four bald eagles from Wall Lake down the East Fork of the Gila to the confluence of the Middle Fork. We saw six bald eagles along the Gila between the Forks and the town of Cliff. We saw one bald eagle just below Cliff, one at Lake Roberts and one at Centerfire Bog. Interestingly, we saw no eagles along the San Francisco River though we flew along it from the lower mouth of the "Lower Box" upstream to Reserve. Bruce Anderson suggested that the considerable turbidity of the San Francisco at the time may have prohibited fishing by eagles and caused them to avoid the San Francisco in favor of other areas. The East Fork of the Gila and the main Gila at least above Turkey Creek were less turbid than the San Francisco, so our observations of several eagles in these areas are consistent with Bruce's hypothesis. Rarely were any of the streams we traversed during the study very clear. Turbidity generally limited visibility in the water to about 18 inches or less. Nonetheless, bald eagles were present along these watercourses constantly.

Though our observations do not permit generalizations about the relation of eagle activity to temperature, precipitation, etc., several workers comment that bald eagle activity is noticeably altered by weather conditions. During cold, rainy or overcast days, eagles are liable to remain in their roost all day (Cooksey 1962: 19; Ingram 1965; Shea 1973: 41; Lish and Lewis 1975; Steenhof 1978) or occupy sheltered perches (Southern 1964). As noted elsewhere, soaring flight is

usually seen only on sunny days.

Difficulties in Studying Bald Eagle Behavior and Diet, and Bald Eagle Responses to Researchers

A detailed account of why bald eagles wintering in a mountainous wilderness area are difficult to study would require a lot of space. Briefly, the difficulties are caused by the birds' mobility, their shyness, the infrequency and unpredictability of their feeding, and the rugged terrain they inhabit.

When hiking along the bottom of a river canyon, one can be certain that virtually every eagle perched in or near the canyon will see the observer before the observer sees the eagle. Most eagles flushed the moment they spotted us, even when we were still 400 meters away. Without exception, an eagle, once flushed, would fly out of our sight. On one occasion an adult we had flushed disappeared upstream, then twice headed back downstream toward us, each time turning back to retreat upstream rather than fly past us. We noticed repeatedly that immatures permitted us to get closer to them before they flew than did adults. Only in a few cases did eagles permit us to watch them at relatively close range.

Locations where temporary or long-term concentrations of eagles exist offer the only realistic possibilities of gaining more detailed knowledge of the diet of eagles in the Gila. At such concentration areas, researchers may find vantage points where they can watch eagles from considerable distance with spotting scopes. Such was the case seven miles south of Cliff where we perched on a bare hillside 1/2 mile from a hog carcass used by eagles, and observed eagles up to a mile or more away. The problem is that, as in this case, such concentrations are often short-lived. Lakes offer promise in

future eagle studies because they are discrete areas where the researcher may scan perches from a distance, without flushing eagles. However, even at lakes which are regularly frequented by eagles, such as Wall Lake, Centerfire Bog, Snow Lake and Lake Roberts, observations of feeding and hunting are few and far between.

Effectiveness of Aerial Search

Fixed-wing aircraft are routinely used in bald eagle censusing (Johnson 1979). Slow-flying craft are more useful than faster ones. In twisting, sheer-walled canyons such as those of the Gila River and its tributaries, however, any fixed-wing plane is of limited usefulness, for reasons obvious to anyone who has attempted such a flight. Even in the best of circumstances, for example, where a uniform band of cottonwoods bounds a broad, meandering river through flat, open terrain, an unknown percentage of the eagles present is undoubtedly missed by censusers. This proportion must be higher in river canyons such as those of the Gila, because of the necessity of flying higher and impossibility of closely following each twist of the river canyon.

Thus, it is of interest to study the efficacy of the aerial census technique when possible, for example, when the total eagle population of an area, known from extensive ground observations, can be compared with the results of a census flight over the same area.

On 8 February, a bald eagle census flight was made by Bruce Anderson, Gary Helbing, David Whitacre, and a pilot experienced in the area, in a twin-engine push-pull Cessna equipped with STOL (short take-off and landing) capability. Although STOL equipment lowers the stall speed of a plane, this plane was still rather fast for low level reconnaissance

work, and we probably rarely moved less than 100 mph. The results of the survey are given on page 25. The section of interest for evaluation purposes is that from Cliff south to section 3 (T 2 S, R 17 W). We saw one immature bald eagle in this section. For the previous four days, 11 bald eagles had been using a one mile stretch of river in section 3. In other words, we saw one eagle in an area where 11 eagles were regularly present. Two adults and one immature were seen during the flight along the river 1/2 mile upstream from the river bridge at Gila. At least one of these adults had been restricting its movements over the past several days to that area, and we had never seen more than one adult at section 3. So, even if two of these eagles were among the 11 we had been observing at section 3, then 3 out of 11 eagles were seen during the flight.

The major factor diminishing the visibility of these eagles during our flight was their probable temporary absence from the river. Eagles often soared extensively during midday hours. It was about 1025 when we flew over section 3, and we suggest that most of the eagles were flying around elsewhere at the time. During such soaring flight, they would be unlikely to be seen during an aerial census, here or elsewhere. One way to minimize this source of error is to limit eagle census flights to the very early morning hours, say sunrise to 0900. As this is impractical, especially when censusing areas far from the airport, the next best solution perhaps is to be aware of this source of error when interpreting the results of aerial eagle censuses.

STUDY AREA ACCOUNTS

Features of each study area are discussed individually in this section. The dates of our visits to each area are presented in Appendix 5.

Gila River Seven Miles Below Cliff

Definition of Area

This extremely high eagle use area occupies about one quarter square mile in the NW 1/4 of section 3 (T 2 S, R 17 W) and the SW 1/4 of adjacent section 33 (T 6 S, R 17 W). The bulk of the area used for diurnal perching, feeding and loafing was on gravel and mud bars, islands and both banks of the Gila River (outlined on map no. 1). A heavily-used roost grove was in the SE 1/4 of the SW 1/4 of the SW 1/4 of section 34 (see map no. 1).

Dates of Coverage

We spent all or part of 5, 6, 7, 10, 11, 12 and 22 February at this site.

Population Estimates by Month

The first indication of heavy bald eagle use of this area was on 1 February when Bruce Anderson and other U. S. F. S. personnel saw one adult and five immatures here (Bruce Anderson Pers. Comm.). Our minimum and estimated population figure for February was 13 immatures and 2 adults. Though eagle use of the area was tapering off toward the end of February, no attempt was made to see whether eagles were still roosting

here in March.

General Habitat Features

The Gila River in this area flows along the western side of a broad (1/2--3/4 mile across), flat-bottomed valley about 2 1/2 miles long. Much of the flat valley bottom (largely east of the river) is pasture at the moment, but much has been cultivated in the past. The narrower level expanses west of the river are, likewise, mostly in pasture. The hills bounding the river valley to both east and west are too steep, rocky and seasonally dry to support agriculture, and are covered with grassland and oak and juniper woodland, and are grazed by cattle.

A varying number of large cottonwoods is sprinkled around on both river banks and on the flat bottomlands back from the river. The river channel at the time of our study bore marks of recent heavy floods. Vast bars of gravel, sand and mud were abundant, and the river in many places divided into several small channels to flow over these bars, creating many small islands. These islands and vast areas of the flat river-side bars were devoid of ground cover or any other vegetation. Driftwood, from mounds of flotsam to mature, uprooted cottonwoods was abundantly scattered in and along the river.

Perches

Bald eagles in this area perched on the ground, on driftwood, and in living and dead cottonwoods. Though some of the time they spent on the ground was a direct result of their feeding at a hog carcass, eagles here habitually spent most of the day perched on logs and driftwood less than 10 feet above the ground, and often perched or walked on the ground, even wading belly-deep in the Gila River, even while far from the carcass, and definitely not feeding. This was

not for lack of taller perches, as sufficient tall cottonwoods (e. g., the roost groves) were nearby to fill any need.

At least a dozen driftwood perches were used, from downed logs two feet in diameter, to limbs two to four inches in diameter, protruding three to ten feet up from the sand (see photos nos. 3 and 4). Eagles perched on tussocks and mounds of flotsam that protruded 12 inches out of the Gila River. They often walked about on gravel bars, when bare and when snow-covered, and occasionally roamed or stood in the river, sometimes deep enough to wet their breast feathers.

It is probably significant that the areas where eagles perched low or on the ground were broad, flat bars, devoid of any ground cover or other vegetation. Thus, four-footed predators, such as coyotes, could not have approached undetected, nor could humans. The area was also very free of human activity. Thus, we feel that the eagles felt safe and secure here, and, accordingly, felt safe perching low, which is behavior we did not observe in the close quarters and crowded vegetation of the river canyons we studied. In addition to many driftwood perches, eagles here used at least two dead and three living cottonwoods during the day (see photos nos. 1 and 5). Nocturnally, more trees were used for roosting.

Roosts

A roost was first discovered here on 5 February, when five eagles moved into cottonwoods west of the river at dusk. At least nine eagles roosted here on 10 February, and at least seven on 11 February. Though we did not make daily roost censuses throughout this time span, it is clear that several eagles which were frequenting the area and feeding on a hog carcass daily, were spending their nights in this roost. The roost area is indicated on map no. 1 and is pictured in photos nos. 5 and 6.

The roost area is actually comprised of three groves containing 21, three and two large cottonwoods, and a single large cottonwood (see Appendix 6 for map of roost). The largest grove (North Grove) is 200 by 40 feet, and stretches immediately along the river bank (a 10-foot high cut bank). South Grove (3 trees) lies 300 feet from the river bank and North Grove, while East Grove (2 trees) is 250 feet from the latter grove and about 200 feet from the river bank. The intervening areas are pasture and low brush.

Diameter at breast height and distance from nearest neighboring tree were measured for all trees of greater than sapling size. Height of each tree was visually estimated. Data for these parameters were combined for all three groves, to give an idea of the density and size of the trees within the roosting area (Table 4).

	Mean	Range	S. D.	N
Diameter at Breast Height	38 "	12-96 "	21 "	27
Height	42 ft	15-60 ft	11 ft	27
Distance to Nearest Neighbor	119 "	1-60 ft	153.5 "	26
Individual Area* per Tree	76.83 square feet			
Density of Trees** per Acre	567			

TABLE 4. SOME MEASUREMENTS OF A BALD EAGLE ROOST GROVE ALONG THE GILA RIVER SEVEN MILES SOUTH OF CLIFF, NEW MEXICO.
* = individual area = πr^2, if D = mean distance from nearest neighbor. ** = Density = $\frac{43560}{\text{individual area}}$ (sq. ft. per acre)

Three densiometer readings taken in North Roost were 81, 86 and 86 (x = 84). This figure gives an idea of the fairly dense nature of this grove, considering the fact that there were no leaves on these trees at the time.

Usually all eagles, or all except one or two, had left the roost groves by 0700 or 0730 when we made our first morning observations. At this time, eagles were mainly perched on driftwood in the river bed. In late afternoon, a slow movement back into the roost trees occurred, with the last eagles arriving in thickening darkness.

Eagles perched in the upper third of these living, leafless cottonwoods, on fairly horizontal limbs about 3-6 inches in diameter, with twig-free areas allowing access to perching spots.

Food Habits and Prey Availability

The primary food source for these eagles was a dead hog laying on a mud bar along the Gila River, as indicated on map no. 1. Details about the size and rate of consumption of the carcass and the behavior of eagles feeding upon it are found on pages 11, 14, and 15. Though eagles pecked at flotsam and sometimes picked up bits of flotsam in their bills, we did not see any actually eat anything except the hog carcass. Occasionally we saw up to two common mergansers (Mergus merganser) along this river stretch. Though we did not look for or see any fish, they undoubtedly are present in this stretch of river.

John Egbert (Pers. Comm.) found a dead cow partly buried in a sand bar along the Gila River on 22 February, at approximately section 23 (T 5 S, R 17 W), near the Indian ruins north of Cliff. Near this location, John Hubbard (Pers. Comm.) had seen two bald eagles perched side by side on a limb the previous day.

Human Disturbance

During our observations here, we saw no cases of eagles being disturbed by human activity other than our own when we mapped the roost groves. The closest human habitation to the roost is about one half mile away, and is marked on the 1959 U.S.G.S. Cliff, New Mexico 15 minute topographic map as the Hap McCauley Ranch. This ranch sets back from the river in a draw, and activity there, minimal during our study, could probably reach much greater intensity before disturbing the eagles. The McCauley property on the east bank of the river here is an intensely utilized hog pasture, covered with short grass and tall annual weeds. If the land-use scheme here were changed to one requiring more human activity in these pastures near the river, it would very likely detract from the area's attractiveness to eagles. Likewise, the area immediately surrounding the roost groves (on the west side of the river) is cattle pasture at present, but any great increase in human activity there would very likely make the roost site unsuitable for eagles.

During 5, 6 and 7 February, a caterpillar and two dump trucks were moving earth about one mile NNE of the roost and eagle perching area. The noise level in the eagles' vicinity was not very high, and the eagles did not seem to respond to this activity at all.

Routine automobile traffic on Forest Road 809 and the road just west of the river did not seem to disturb the eagles at all.

In summary, though the roost, perching and feeding areas used by these eagles are not very far from several ranches and are surrounded by pastures and roads, the broad river bars and large pastures create a large enough refuge of low human use area that the eagles evidently felt at home here. However, it would be very easy for increased human use of the area, or cutting of roost trees, etc., to render the

area unsuitable for bald eagle use.

Specific Recommendations

1) These roost groves should be monitored periodically during coming winters, to see whether this is a traditional and important roost area, used year after year.

2) Steps should be taken to ensure the preservation of the roost groves.

3) If management measures such as augmentation of bald eagle winter food supply by distribution of carcasses are ever employed in the Gila National Forest area, we would recommend this site for such measures. We recommend this site because a) we know that bald eagles do concentrate here at times, at least while a carcass is available, 2) a roost site is present, and 3) the site seems to be quite free of human disturbance.

Lower East Fork of the Gila River

Definition of Area

This stretch of river comprises about 14 miles of channel, from its confluence with the combined West and Middle Forks, upstream to the boundary between sections 22 and 27 (T 12 S, R 13 W)(the arbitrary division point between this study area and the "Upper East Fork" study area).

Dates of Coverage

14, 15 January; 13, 14, 15 February; 11, 12, 13 March.

Population Estimates by Month (Immatures / Adults)

Minimum			Estimated		
Jan.	Feb.	March	Jan.	Feb.	March
1/1	4/3	3/2	1/2	5/3	4/5

General Habitat Features

The character of the East Fork in this stretch varies from a narrow, cliff-bounded canyon with few cottonwoods along the river, to a broad, open river bottomland with many large cottonwoods, fewer Arizona sycamores (Platanus Wrightii), and often a belt of other broad-leaved tree species at the foot of conifer-clad slopes. Open pastures adjacent to the river characteristically showed signs of heavy cattle grazing (e. g., hoofprints, cow dung) and increasers such as goldenrod (Solidago sp.) and Russian thistle (Salsola kali) were abundant. Regeneration of cottonwoods in general was uncommon, with a few dense stands of saplings being notable exceptions. In many areas broad grama (Bouteloua gracilis, B. curtipendula) benches interdigitate with oak, juniper, pinyon and ponderosa pine stands above the canyon walls or high river banks.

Perches

Eleven diurnal perch trees were located along this segment of the East Fork. Five of these trees were ponderosa pines, four were cottonwood species, and one was a Gambel oak and one a probable hackberry. The mean distance of perch trees here from the river (70 feet) is less than in other riverine areas, because 80 percent of the perch trees were in the river bottomland or along the bases of hills that form the river banks. In other words, riparian vegetation provides 80 percent of the bald eagle diurnal perch trees in this area.

Species Composition		Height	DBH
Ponderosa pine	45 %	$\bar{x}$=40 ft	$\bar{x}$=24 "
Cottonwood spp.	36 %	SD=11 ft	SD=7 "
Gambel oak	9 %	N=9	N=4
Hackberry	9 %		
N=11			

Topographic Position	Approximate Distance to River
80 % river bottomland	$\bar{x}$=70 ft
20 % hillside	Range = 8-300 ft
	SD=90 ft
	N=8

TABLE 5. Characteristics of perch trees along the lower East Fork of the Gila River.

Roosts

One probable roost tree was located on this river segment, about one mile upstream from Lyon's Lodge (NE 1/4, NW 1/4, sec. 10, T 13 S, R 13 W)(#1 on map no. 2). This ponderosa pine, 55 feet tall and 2 feet diameter at breast height, was mostly living, with an intact crown, and was positioned at the edge of the forest along the river's edge. A four to six inch diameter limb in the middle third of the crown had evidently been heavily used by perching and/or roosting eagles, as it and the ground below were heavily spattered with whitewash. At least three castings (pellets) were collected from the ground below this limb (see Food Habits). Judging from the high degree of bald eagle use of this entire river segment, it seems very likely that either this tree serves as a communal roost, and/or, that other roost trees are also used.

Food Habits and Prey Availability

As discussed under Food Habits (p. 10), pellets and prey remains found below a presumed roost tree in this area and one at the mouth of Beaver Creek (Upper East Fork study area) contained deer (Odocoileus sp.) hair, fish scales, feathers and bones of a robin-sized bird, a frog (Ranidae) and jaws and fur of a small rodent. We did not observe any eagles feeding in this study area. A four-year old eagle we observed on 14 February seemed to be watching for fish or other aquatic prey. This bird (2/14-4 on map no. 3), allowed us to watch him for two and a half hours at relatively close range, an unusual occurence. It was perched in a ponderosa pine snag beside a river pool (see photo no.12) when we located it at 0925. For 30 minutes it remained here, frequently looking down toward the river. Then it moved 100 m upstream to a similar pine snag and again gazed frequently downward at the river before moving off at 1126 to join an adult circling upstream as a fresh breeze arose. This eagle seemed to ignore two common mergansers which were on the pool below its perches. We saw no fish during our hikes along this river segment, but usually saw 3 or 4 mergansers, and once, eight mallards along this stretch. A freshly stillborn calf lay on a grassy bench very near the perches used by the fourth-year eagle just mentioned, but was not visited, and probably not detected, by either the immature or the adult as they circled not quite directly over it.

Human Disturbance

In general, we found it difficult to make observations on bald eagle behavior along this river stretch. This was true for reasons presented on page 26. It is clear that repeated human movements along this stretch could make bald eagles change perches frequently. On the other hand, exist-

ing human structures and activities during our visit did not seem to keep bald eagles from using the stretch of river about three miles from the confluence with the combined West and Middle Forks, where two out of three ranches had humans present. An immature eagle was perched in a cottonwood on the river bank in front of the XSX Ranch. The ranch house and buildings here sit well back from the river (ca. 2-300 m), which probably minimizes the potential for disturbance of eagles. Probably only the ranch foreman was present, and no activity on his part was evident when we passed the ranch. At the second ranch, moving upstream (called The Hacienda), a bald eagle was perched 2-300 m upstream from the house, which was unoccupied. At the third and last ranch, Lyon's Lodge, the caretakers told us that an adult bald eagle had been seen almost daily .

Movement of humans upstream of Lyon's Lodge during the winter is probably rare. The occasional passage of a rancher or hiker and consequent flushing of an eagle or two would not be expected to lessen the value of this area to bald eagles.

Specific Recommendations

The roost tree we located should be checked in comming winters, not only to learn whether it is an important roost, but on the possibility that castings found below it may reveal information about the diet of eagles in the Gila.

Upper East Fork of the Gila River, Taylor, Hoyt and Beaver Creeks and Wall Lake

Definition of Area

This area is comprised of about 11 miles of the East

Fork, from the upstream end of the "Lower East Fork" study area (boundary of sections 22 and 27, T 12 S, R 13 W) to the confluence of Beaver and Taylor Creeks, the lower three miles of Beaver Creek, and two miles of Taylor Creek (from Beaver Creek to one half mile above Wall Lake) and Wall Lake and the mouth of Hoyt Creek. It is an important area to bald eagles wintering in the Gila National Forest.

Dates of Coverage

We spent all or parts of 17, 18, 19, 20 and 21 February and 7, 8, 9, 23, 24 and 25 March in this area.

Population Estimates by Month (Immatures / Adults)

This area was not visited in January, so no population estimates are available for that month.

Minimum		Estimated	
February	March	February	March
2/3	1/3	2/4	1/3

General Habitat Features

The range of habitat features found within this survey area is broader than that encountered along the lower East Fork. Wall Lake, a highland lake which is little-disturbed by man in winter is one major difference between the two areas. Taylor and Hoyt Creeks are small creeks bordered with many large cottonwoods; at our visits in February, both were flowing over broad, braided channels among extensive gravel flats, providing habitat heavily used by a small number of green-winged teal (Anas carolinensis) and mallards. Diamond Creek, another tributary larger than these first two, has a broad valley and many cottonwoods. Beaver Creek flows through a

narrower, canyon-like valley with less extensive cottonwood stands. Taylor Creek, from Wall Lake to its confluence with Beaver Creek, flows through two very steep, narrow, rock-walled canyons, with almost no floodplain within them. Some river stretches in this survey area seemed to have fewer cottonwoods than any floodplain segment of the lower East Fork. Notably, section 1 (R 13 W, T 12 S) had only a few large cottonwoods, though floodplain development is ample between the steep canyon walls. The scarcity of cottonwoods in section 1 is such that an eagle would have to look a long way to find a tree in which to perch near the river.

Probably more, though highly localized, regeneration of cottonwoods and willows was observed in this segment of the East Fork than in the lower stretch, especially just below the DD Ranch, and in sections 10, 15 and 22 (T 12 S, R 13 W). Still, the amount of regeneration is small, and intermediate size classes which would be expected to replace the lingering monarchs of these floodplains are scarcely to be found. Some stands of willow saplings showed the effects of browsing by cattle and/or horses in sections 10, 15 and 22 (see photo no. 26). Cattle, horses and their sign were present all the way from the confluence of Beaver and Taylor Creeks, to the downstream end of this segment (section 22).

Perches

We found nine diurnal perch trees along the upper part of the East Fork, two in the vicinity of Wall Lake, and one along Taylor Creek. Like that in the lower portion of the East Fork, the riparian habitat here is important to bald eagles wintering along the upper East Fork and its tributaries; 60 percent of the trees used as perches were cottonwoods, while 70 percent of perch trees were located in the river floodplain.

Both of the perch trees at Wall Lake are ponderosa pines. One is a fifty foot tall, living tree, thirty feet

from the lake shore; it was used on several occasions by an adult bald eagle. The other perch tree is a 65 foot snag with a multitude of stout, horizontal dead limbs, 125 feet from the lake; it was used by an adult and at least two immatures. The eagles using these lakeside perches were very shy, which made it impossible to discern whether they used these trees as hunting or roosting perches.

Species Composition		Height	DBH
Ponderosa pine	30 %	$\bar{x}$ = 45 ft	$\bar{x}$ = 39 "
Cottonwood spp.	60 %	SD = 7 ft	SD = 20 "
Hawthorne sp.	10 %	N = 9	N = 8

Topographic Position	Approximate Distance to River
70 % floodplain	$\bar{x}$ = 83 ft
30 % hillside	SD = 72 ft
	N = 8

UPPER EAST FORK OF GILA AND TAYLOR CREEK

Ponderosa pine 100 %
Height-- $\bar{x}$ = 58 ft, N = 2
100 % lakeshore, N = 2
Approximate Distance to Lake-- $\bar{x}$ = 78 ft, N = 2

WALL LAKE

TABLE 6. CHARACTERISTICS OF PERCH TREES ALONG THE UPPER EAST FORK OF THE GILA, TAYLOR CREEK AND WALL LAKE.

Roosts

A probable roost was located along Beaver Creek, about 200 meters upstream from its confluence with Taylor Creek (SW 1/4, NE 1/4 sec. 17, T 11 S, R 12 W)(see #3 on map no. 6). On 24

March, Kate and Roger Skaggs discovered a ponderosa pine that had much white wash on the ground below the tree and on a branch in the upper third of the crown. Several pellets were found beneath the tree. This live ponderosa pine was 45 feet tall, 30 inches diameter at breast height, on a gentle hillside of mixed ponderosa pine, pinyon, juniper and oak, and was about 50 feet from Beaver Creek.

Food Habits and Prey Availability

As discussed under Food Habits (page 10), 8-10 pellets found under a probable roost/perch tree along Beaver Creek on 24 March contained fish vertebrae and scales, feathers, bones of a robin-sized bird, a jaw of a mouse-sized rodent, and about four kinds of fur, including probable small rodent and deer hair. A desiccated frog was also present. Also, as discussed in the same place, two mammal carcasses in a garbage ditch at Wall Lake may have been fed upon by eagles; there is no direct evidence of this, however. We did not see any eagles with prey. An adult we watched from 1050 til 1158 on 19 February spent much of this time gazing downward at the East Fork of the Gila, about 18 feet below him (2/19-A, at SW 1/4 of sec. 1, T 12 S, R 12 W, map no. 4). Though four puddle ducks (probably mallards) were virtually below him on the river throughout this period, he did not seem to pay attention to them, nor they to him. We had the impression that this eagle was watching for fish or other aquatic prey, though the river was turbid.

We consistently saw more waterfowl along the upper East Fork than we did along the lower East Fork, including up to 12 puddle ducks in one group (11 mallards and 1 pintail (Anas acuta)). Especially attractive to ducks was the marshy area where House Spring drains into the East Fork. We also saw a few fish in the East Fork. In Beaver Creek, on 24 March, R. and K. Skaggs saw many 6-12 inch suckers, several frogs

and a garter snake.

There were ducks, coots and grebes on Wall Lake during each of our visits. Census totals are presented in Appendix 1. Briefly, there were three times as many waterfowl present in mid-February as there were in early March. Though other observers mention finding duck remains along the shore of Wall Lake (Gast, Hunt, Garcelon and Hanna 1978) and have seen eagles chase ducks here (Anderson 1979), we could find no prey remains or castings in a search of the lakeshore and below the two main eagle perch trees and other prospective perches.

Though we tried to observe eagle behavior at Wall Lake, we met with little success, as described in the following section. We feel that a tactic we adopted the morning of 21 February would be useful in any future studies of bald eagles at Wall Lake. We entered an ancient cliff dwelling on the bluff which forms the eastern lake shore, well before dawn. From the door of this blind, we could see the southeastern portion of the lake, the mouth of Hoyt Creek and the tall Ponderosa snag eagle perch. Though no eagles appeared on this morning, we feel that the technique would eventually pay off in candid eagle observations.

Human Disturbance

The apparently small amount of human activity at Wall Lake during the winter no doubt enhances the usability of this lake to bald eagles. Even our discrete activity around the lake seemed to drive eagles away from the lake quite effectively. The early morning of 18 February, one adult and two immature bald eagles were perched in the tall ponderosa pine snag (photo no. 9) at Wall Lake. Whitacre approached the lake on foot along the access road from the north, halting as soon as this snag (and the eagles) were visible. He then retreated away from the lake and into the woods to spy on the eagles from a more hidden viewpoint. The adult flew away almost

immediately, while the immatures remained, apparently until flushed by a trio of illegal aliens walking along the lakeshore road. None of the eagles returned to the lake by mid-morning. Similarly, two adults which left the lake vicinity upon our arrival there the morning of 17 February did not return, though we watched, at least nominally concealed, from a hilltop, all day. Either the presence of humans prevented these eagles from returning to the lake, or, equally plausible, bald eagles do not generally use Wall Lake after the morning hours, and, after human intruders have scared them away, they remain gone for the day, frequenting other areas as they would have done regardless of human presence.

Human activity throughout the remainder of this study area is almost totally restricted to the vicinity of the Trail's End and DD ranches, and is probably of very minor importance to wintering eagles.

Nesting Search

As described on page 18, we and Ron Warren observed possible bald eagle courtship at the junction of Beaver and Taylor Creeks on 18 February and 3 April. Ron Warren's statement (Pers. Comm.) that he saw bald eagles in the area as late as May in 1978 may also be interpreted as evidence of nesting in the area.

On the basis of these suggestive observations, we searched for evidence of nesting bald eagles along Beaver Creek, the upper East Fork of the Gila and Wall Lake on 7, 8, 9, 23, 24 and 25 March. Though three stick nests were located on cliffs along Beaver Creek and one in a ponderosa pine in a small canyon nearby, there was no evidence of occupancy on 24 March during a ground search, or on 26 March when we flew over them.

In summary, we found no bald eagles nesting in this study area, but did find enough suggestive evidence that it

seems to be a likely area for future bald eagle nesting. Possible courtship observations were centered around Beaver Creek. Intuitively, Wall Lake would seem to be a good place for bald eagles to nest, but the heavy spring and summer human use that it sees would almost certainly doom any nesting attempt there to failure.

Specific Recommendations

Any future bald eagle studies in the Gila N. F. would do well to 1. check the Beaver Creek roost tree to verify roosting there and collect food habits data from castings, and 2. employ the cliff dwelling at Wall Lake as a blind for observing bald eagles at the lake.

The only management recommendation we would make for this study area is to increase cottonwood regeneration along the upper East Fork of the Gila River, presumably by planting trees and/or the exclusion of livestock from certain areas.

Negrito Creek, South Fork of Negrito Creek and Tularosa River

Definition of Area

This area is comprised of about seven miles of Negrito Creek from the junction of the North and South Forks of Negrito Creek to the center of section 22, T 7 S, R 18 W, and three miles of the lower end of Negrito Creek, from its confluence with the Tularosa River upstream to the center of the south half of section 21. The south fork of Negrito Creek was also surveyed, from its mouth to section 5 (T 2 N, R 17 W) where it joins forest road 141. The Tularosa River was surveyed from the end of the road at Cecil Beard's house (SE 1/4 sec. 24, T 4 N, R 19 W) to the confluence of Negrito Creek.

Dates of Coverage

9, 10 and 11 January, and 24, 25 and 26 February, and 16 and 17 March.

Population Estimates by Month (Immatures / Adults)

Minimum			Estimated		
Jan.	Feb.	Mar.*	Jan.	Feb.	Mar.*
1/3	6/2	3/1	1/3	6/4	3/2

General Habitat Features

Eagles were seen only in the five mile stretch from the forks of Negrito Creek downstream to section 26 (T 7 S, R 18 W). This five mile segment is the site of heavy use by wintering bald eagles, and evidently is an important roosting area, as was indicated by surveys made last winter (1977-78) as well as the present study.

The environs of Negrito Creek in this area are noticeably different in some major aspects from the East Fork of the Gila River. The main difference is that here, steep, usually wooded ridges drop down to a usually narrow floodplain, in contrast to the broader floodplain of the East Fork. In the area surveyed, actual rock cliffs are scattered, and do not form rimrock canyon walls with large grassy juniper-dotted benches above, as are common along the East Fork of the Gila. Grassy benches are present along the North Fork of Negrito Creek, but are rare below the forks, along the segment discussed here.

* March coverage was not as complete as were January and February coverages, so March population estimates are not strictly comparable to the two earlier estimates, but are probably underestimates.

Cottonwoods are about equally common along Negrito Creek and the East Fork of the Gila. Alders (Alnus sp.) are much more abundant along Negrito Creek, but probably rarely attain a size offering usable perch limbs to bald eagles. The creek itself is smaller than the Gila East Fork, and has a steeper gradient. As along the East Fork, cattle and horses have grazed heavily in this area. Goldenrod (Solidago sp.) is abundant in creek-side pastures, but Russian thistle (Salsola kali) is less common than along the East Fork. Very little grass could be seen in these pastures.

In general, dense stands of large ponderosa pine are more common on the canyon walls of Negrito Creek than along the Gila East Fork, and far more ponderosas are dotted about in the floodplain here than is the case along the Gila East Fork. Ponderosa pine snags are abundant on many hillsides.

Perches

Sixteen perch trees were located along Negrito Creek. This represents the highest ratio of perch trees found to miles travelled of all our study areas (16:5, compared to 11:14 for the lower East Fork, and 12:16 for the upper East Fork, Wall Lake, etc. area). Negrito Creek also has the highest proportion of perch trees on hillsides as compared to on the floodplain proper. This is due to the narrowness of the floodplain and the ample selection of perch trees on the steep hillsides which flank the creek. Table 7 gives attributes of perch trees.

Species Composition	Height	DBH	Topography	Distance to Creek
Ponderosa pine 56 %	$\bar{x}$=54 ft	$\bar{x}$=29 "	50 % hillside	$\bar{x}$=260 ft
Cottonwood spp. 44 %	SD=14 ft	SD=11 "	50 % floodplain	SD=306
N=16	N=11	N=10	N=16	N=15

TABLE 7. CHARACTERISTICS OF PERCH TREES ALONG NEGRITO CREEK.

Roosts

Four roost trees were located on Negrito Creek (# 6 and # 5 on map no. 7). Roost 6 coincides in location with the 1978 roost reported by Gast, Hunt, Garcelon and Hanna (1978). This tree, a 70 foot ponderosa pine 30 inches in diameter, grows near the bottom of a steeply rising hill, about 150 feet above Negrito Creek. At dusk (1700) on 10 January, Gary Falxa and Dirk Lanning observed a five year old bald eagle perched 10 feet below the top of this live tree, on the inner one third of a limb. Above the perch limb was a dense cover of foliage. This tree affords a good view of Negrito Creek. On 25 February, D. Ukrain and D. Whitacre found three probable roost trees/areas. Roost # 7 (map no. 7) was found at 1715, and is composed of two trees. An adult and a third year eagle were perched in a living 45 foot cottonwood along the creek bank, and another third year eagle was perched in a nearby living ponderosa pine also near the creek. Roost 5 (photo no. 24) is a dead ponderosa pine bifurcated in the upper one third of trunk. A first year bald eagle was perched on one of the arms of the Y and a two year old eagle was perched on the other arm. This tree was near the top of a short, steep hill adjacent to Negrito Creek.

All four of these probable roost trees provide good vistas of Negrito Creek. They also overlook an area that is occasionally travelled during the day by local ranchers. Late afternoon and evening disturbance by humans is probably rare.

General Account of Eagle Use

Though some eagles seemed to leave the area during the day, at least partly by moving downstream, others spent all or most of the day in the area reported on here. As we noted in other areas as well, eagles often soared to great

heights and over large areas from late morning until late afternoon. Up to three bald eagles soared together, sometimes in company with golden eagles and ravens.

Food Habits and Prey Availability

As discussed under Food Habits, we found evidence that one or more bald eagles had been feeding on a deer carcass along Negrito Creek (at # 10 on map no. 8; NE 1/4, sec. 2, T 8 S, R 18 W). This carcass was gone by late February when we again surveyed the area. There were more eagles present in February than in January, so it is clear that the deer carcass was not the only attraction to eagles of this area.

We found no other information on bald eagle diet in this area. Though we were suspicious at first that the eagles very near the Kiehne ranch might have been attracted by livestock carrion, we could find none. The 400 head of cattle run on this ranch's grazing permit were on winter range on grassy benches NE of the ranch, above the North Fork of Negrito Creek. Apparently the eagles congregate in the five miles below the Kiehne ranch mainly for roosting purposes. The density of eagles per mile of creek here is about twice what it is along the East Fork of the Gila River, and we saw eagles roosting here in January and February, as did an eagle survey crew the previous winter (Gast, Hunt, Garcelon and Hanna 1978).

Negrito Creek was somewhat turbid but not opaque during our January and February visits. The bottom was visible in areas 18 inches or more in depth, and the creek level was high but not flooding. Though we looked, we did not see any fish. In January, Falxa and Lanning saw a snipe (Capella gallinago), a kingfisher (Megaceryle alcyon), several dippers (Cinclus mexicanus) and two ducks.

Human Disturbance

It is interesting to note that bald eagles were most abundant in the few miles of stream immediately below the Kiehne ranch. In fact, one eagle was perched in a cottonwood virtually in the ranch yard, and at least three others were perched less than 250 meters from the ranch house. As before, we noted that immature eagles sometimes allowed us to approach closer than did adults. Eagles here flushed when we were from 200 to 400 meters from them. Because of the abundance of perches on the hillsides and the fact that eagles used them heavily, we found it difficult to spot perched eagles before they flushed.

The potential for disturbance of these eagles by other than the caretakers of the Kiehne and Brennand ranches is low. Mr. A. D. Mays, caretaker of the Kiehne ranch, requires that people passing through deeded land (including the stream valley around the ranch) obtain permission from him before passing beyond the ranch house. He is protective of the eagles; when we told him we were interested in seeing bald eagles, he commented that he did not want anyone shooting them, and that "everybody knows they're protected by law".

Historical Indications of Bald Eagle Wintering and Nesting along Negrito Creek

We talked with three residents or past residents of Negrito Creek, all of whom spoke confidently of a long, steady history of bald eagle use of this canyon.

Jess Brennand said that six to eight bald eagles have wintered along the creek every winter for the past 33 years, his time of residence there. He said he has seen a bald eagle catch a great blue heron, and that he is certain they also feed on squirrels and fish. He saw one scare two coyotes from the carcass of a stillborn calf and then feed on it.

Bill Brennand said that bald eagles nest along Negrito Creek about every three or four years. He said that a pair of adults fledged young from a stick nest in a large cottonwood at the confluence of Sign Camp Canyon and Negrito Creek several years ago. This stick nest was still extant until the winter of 1977-78, when the tree was taken down by a flood.

Tom Lee Kiehne of Luna, who was brought up on the Kiehne ranch, said that bald eagles have wintered along Negrito Creek for as long as he can remember. He stated that they have nested on the north slope of the canyon, midway between Sign Camp Canyon and the Kiehne Ranch.

Specific Recommendations

Future studies of wintering bald eagle use of riparian habitats in the Gila N. F. would do well to make the five mile stretch of Negrito Creek from the Kiehne ranch downstream an intensive study area. We suggest this because: 1.) concentrations of bald eagles here are higher than anywhere else except the hog carcass site, 2.) the area is accessible all winter, though four wheel drive may be required much of the winter.

No management recommendations seem necessary, other than to prevent any major activity such as logging, which would destroy roosting and perching sites and drive eagles away.

Snow Lake

Definition of Area

Observations were made from the shores of Snow Lake, on eagles that frequented the lake, the nearby hillsides and surrounding air space.

Dates of Coverage

6, 7 and 8 January; 13 and 14 April. Snows prevented access in February and March; we made several low-level airplane passes over the area on 8 February.

Population Estimates by Month (Immatures / Adults)

Minimum		Estimated	
January--1/3	April--0	January--1/4	April--0

No estimates available for February and March.

General Habitat Features

Snow Lake is a 100 acre lake constructed by the New Mexico Department of Game and Fish (Gast, Hunt, Garcelon and Hanna 1978), by construction of a small dam across Snow Canyon. At 7320 feet elevation, Snow Lake normally freezes over completely during mid-winter (Bruce Anderson, Pers. Comm.). Such was the case this year. Snow Lake is perched along the south edge of a broad, high, rolling plateau; just south of the lake, wooded canyon walls drop off steeply into the Middle Fork of the Gila River.

To the NW, N and NE of the lake, gently rolling plains extend, covered with grasses (largely Bouteloua spp.) and, in places, with a scattering of junipers (ca. 1 tree / acre). On the south and southeast sides of the lake, wooded ridges rise steeply from near the lake shore. These slopes are cloaked, thinly on the lower slopes, densely toward the ridge tops, with 40-60 foot ponderosa pines, with a liberal scattering of pine snags of similar height. The understory is of juniper, Gambel oak and grasses.

Perches

We observed eagles to use six perch trees near Snow Lake. All were ponderosa pines, four being snags, one being alive with a broken top, and the last one alive with a dead, intact top. Five of them were on the wooded ridge just southeast of the lake, while the remainder was amidst open juniper-grassland just under a mile north of the lake (see nos. 3-8, map no. 9).

This pattern of perch use is quite similar to that observed by Gast, Hunt, Garcelon and Hanna (1978). In fact, one perch tree, and possibly a second, was used in both years.

Perch trees ranged in height from 40 to 75 feet, averaging 58 feet tall. In all cases, eagles perched in the upper one third of the tree, on stout, fairly horizontal dead limbs without foliage or twigs obstructing access to or visibility from the limb. Three of the perch trees were located in stands we considered continuous, one was in a broken stand, while two were in stands of isolated trees. Crown density of the stands varied from one percent to 60 %.

Roosts

We found no evidence of roosting near the lake. Falxa and Lanning had the impression on 6 January that the eagles frequenting the lake area roosted somewhere out of sight of the lake, perhaps down Snow Canyon toward the Middle Fork of the Gila. However, the wooded ridges just south and southeast of Snow Lake seem to be suitable roosting habitat, as is suggested by prior observations (Gast, Hunt, Garcelon and Hanna 1978).

Food Habits and Prey Availability

We did not succeed in gathering any new information

about bald eagle diet at Snow Lake. On 6, 7 and 8 January the lake was turbid, with only 2-3 inches visibility into the water. Eighty or 85 percent of the surface was frozen, so fishing conditions for eagles were probably poor. About 60 waterfowl were present (see Appendix 4). At this time, the eagles did not appear to be utilizing the lake as a food source; rather, they seemed to be moving around over a large area near the lake.

On 8 February, when we flew over the lake, it was completely frozen and covered with several feet of snow. There were no waterfowl present, and we saw no eagles during the course of several low passes. On 26 March the lake was free of ice. On 13 and 14 April, about 30 waterfowl, mostly coots, were present on the lake, but no eagles were seen.

Human Disturbance

No human activity was noted by Falxa and Lanning during their 6, 7 and 8 January visit, nor was any noted on 8 February and 26 March when we flew over the lake. Probably very few people visit the lake during the height of winter, due to the difficulty of access. On 13 and 14 April (Easter weekend), 40-50 people were at the lake camping, fishing, etc. By this late date, few eagles remained in the National Forest. Such intense early spring human visitation probably eliminates Snow Lake as a potential bald eagle nesting site, but is too late to be detrimental to most wintering eagles.

Specific Recommendations

We would discourage future eagle researchers from attempting to study bald eagles in mid-winter at Snow Lake because of the difficulty of access due to deep snow.

Centerfire Bog

Definition of Area

We made bald eagle observations at Centerfire Bog and the immediate vicinity.

Dates of Coverage

4 and 5 January; 20, 21 and 31 March; 1 April. We flew over the Bog on 8 February.

Population Estimates by Month (Immatures / Adults)

Minimum		Estimated	
January	March/April	January	March/April
0/2	1/2	0/2	1/2

No estimates available for February, when accessibility was questionable, due to snowy, muddy road.

General Habitat Features

The habitat here is described by Gast, Hunt, Garcelon and Hanna (1978). Photo no. 16 is a panorama showing the character of the bog and its surroundings.

Perches

Two perch trees were used on 4 and 5 January. They were ponderosa pines, one a snag 75 feet tall, the other a live tree 55 feet tall. They were 1 mile and 1 1/8 mile from the bog, respectively (nos. 5 and 6, map no. 10). Both trees were situated in small stands of 90 percent ponderosa pines 10-50 feet tall, with some junipers and oaks, surrounded by extensive, gently sloping grasslands.

Roosts

One roost tree was located when an adult bald eagle spent the night of 4 January in it (no. 4 on map no. 10). This tree was a living ponderosa pine 50 feet tall, and 20 inches in diameter. The roost limb was in the middle one third of the tree. The tree was 3/4 mile SSE of the bog, in a saddle on a hilltop at 7400 feet elevation. The surrounding vegetation was predominantly ponderosa pine 20-50 feet tall, with a few scattered larger individuals, and small, scattered Gambel oaks and pinyons. The stand was continuous but thin, with 0-40 percent crown cover. Less than 5 percent of the stand was comprised of snags.

Food Habits and Prey Availability

We did not find any definite information about the food habits of eagles at Centerfire Bog. Remains of a wild turkey and a cinnamon teal found near the bog on 31 March and 1 April may have been from birds eaten and/or killed by bald eagles, but we have no direct evidence of this. No waterfowl were present, nor fish available, on 4 January when the bog was completely frozen over, nor on 8 February, when 95-98 percent of the bog was frozen. On 31 March and 1 April, 201 waterfowl and shorebirds were counted, half of these being coots (see Appendix no. 4). Small mammals and/or carrion would seem to be the most likely food source for eagles in this vicinity in mid-winter.

Human Disturbance

As the access road is often passable only by four wheel drive vehicles during winter, the potential for human disturbance during the winter is fairly low. The landowner, Pat Jenks, had a family staying in his cabin 1/2 mile NE of

the bog, in a caretaker capacity during parts of this winter. The presence of such caretakers could help prevent disturbance to eagles if the caretakers themselves are aware of how to avoid disturbance, and are conscientious. Otherwise, they themselves could be a disturbance to the eagles.

Bald Eagle Nesting at Centerfire Bog

A pair of adult bald eagles began to nest at Centerfire Bog this spring. John Hubbard notified us in late March (Pers. Comm. to R. and K. Skaggs) of the discovery of a pair attending a nest. Roger and Kate Skaggs visited the bog on 31 March and 1 April and made observations on the behavior of this pair and the nest.

The nest tree is a ponderosa pine 55 feet tall, about 150 meters east of the small bay on the east side of the pond, on a moderate hillside. The nest is in a crotch in the upper third of the tree, against the main trunk, and is made of limbs 1-2 inches in diameter.

Incubation was in progress on 31 March and 1 April. On 31 March, one eagle incubated from 1309 until 1655, when it left the nest to chase a golden eagle that was harassing the other pair member. The other eagle then took over incubation duty, remaining on the nest until just after sunset at 1825, when it left the nest and flew out of sight. The eggs apparently were not incubated during the night. On 1 April, one eagle incubated all day, from 0730 till 1524 when observations ceased.

No prey was brought to the nest during our observations, nor were eagles seen with prey. The pair member that was not incubating was visible at times in the bog area, and sometimes perched in the nest tree and in two perch trees indicated on map no. 10.

MANAGEMENT RECOMMENDATIONS

Some specific recommendations for management and further studies were given under the discussions of each study area. In addition, we recommend the following:

1.) Regeneration of riparian trees should be increased. As discussed earlier, young year classes of cottonwoods and other riparian species are rare in many areas, and this condition will result in a paucity of bald eagle perch/roost sites along river and creek banks, if the rate of new tree growth is not increased. Some combination of seedling planting and exclusion of livestock would probably be the best way to achieve this end.

ACKNOWLEDGEMENTS

We are grateful to Peter Schmit of Operation Breakout for the loan of office space and typewriter during preparation of this report, to Maurice A. Whitacre, who critiqued parts of the manuscript, and to Bruce Anderson, who gave us many helpful suggestions for the study approach and information about access, road conditions, etc.

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KEY TO MAPS

MAP 1 HIGH EAGLE USE AREA 7 MILES SOUTH OF CLIFF
Self explanatory.

MAP 2 LOWER EAST FORK OF GILA RIVER
1 = roost tree

MAP 3 LOWER EAST FORK OF GILA RIVER
Self explanatory.

MAP 4 UPPER EAST FORK OF GILA RIVER
Self explanatory.

MAP 5 UPPER EAST FORK OF GILA RIVER
Self explanatory.

MAP 6 UPPER EAST FORK OF GILA RIVER, WALL LAKE, ET .
1 = live ponderosa pine eagle perch tree.
2 = dead ponderosa pine eagle perch tree.
3 = roost tree.

MAP 7 UPPER NEGRITO CREEK
1-4 = eagle perch trees.
5-7 = eagle roost tr es.

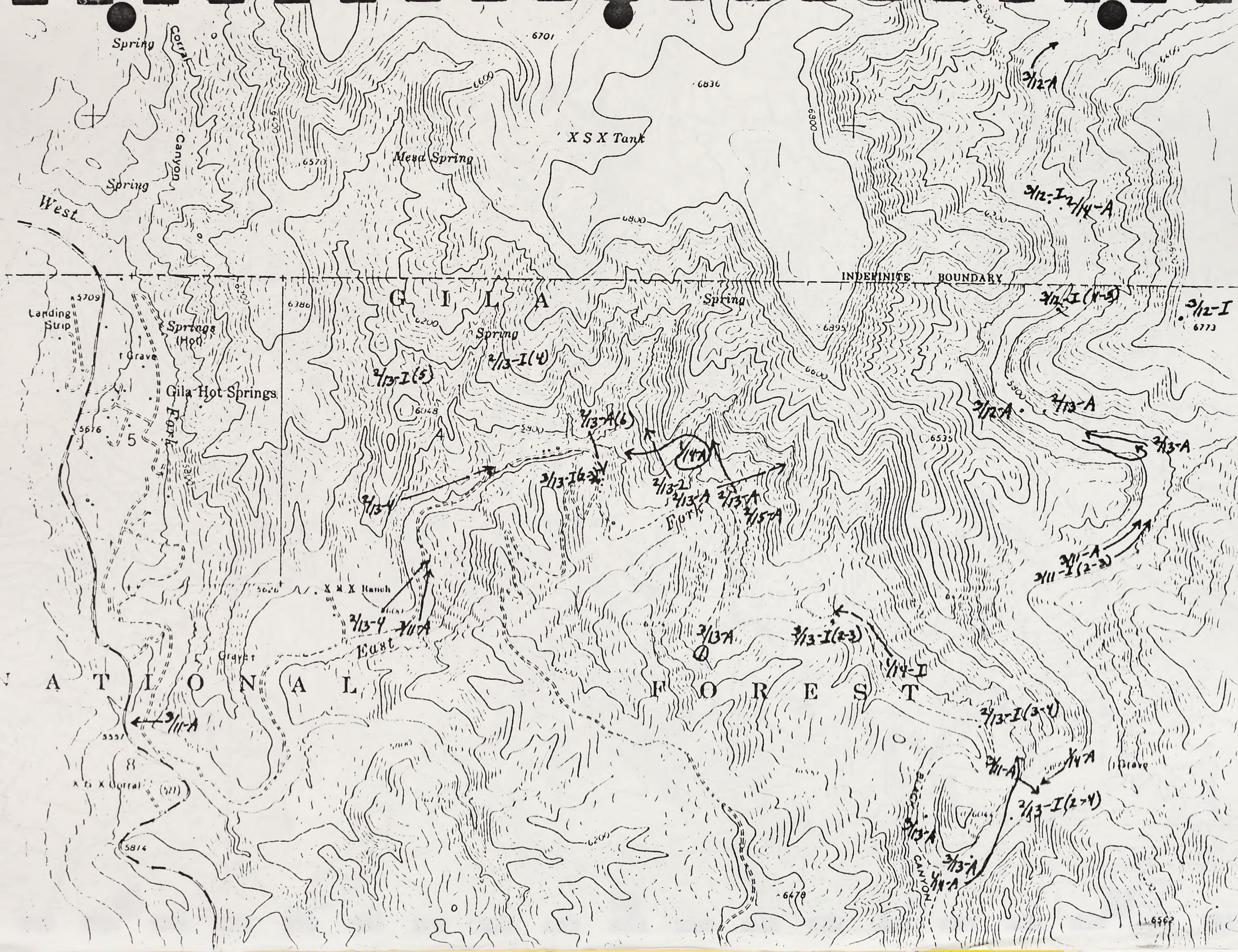
MAP 8 UPPER NEGRITO CREEK

6, 9, 10-14 = perch trees.

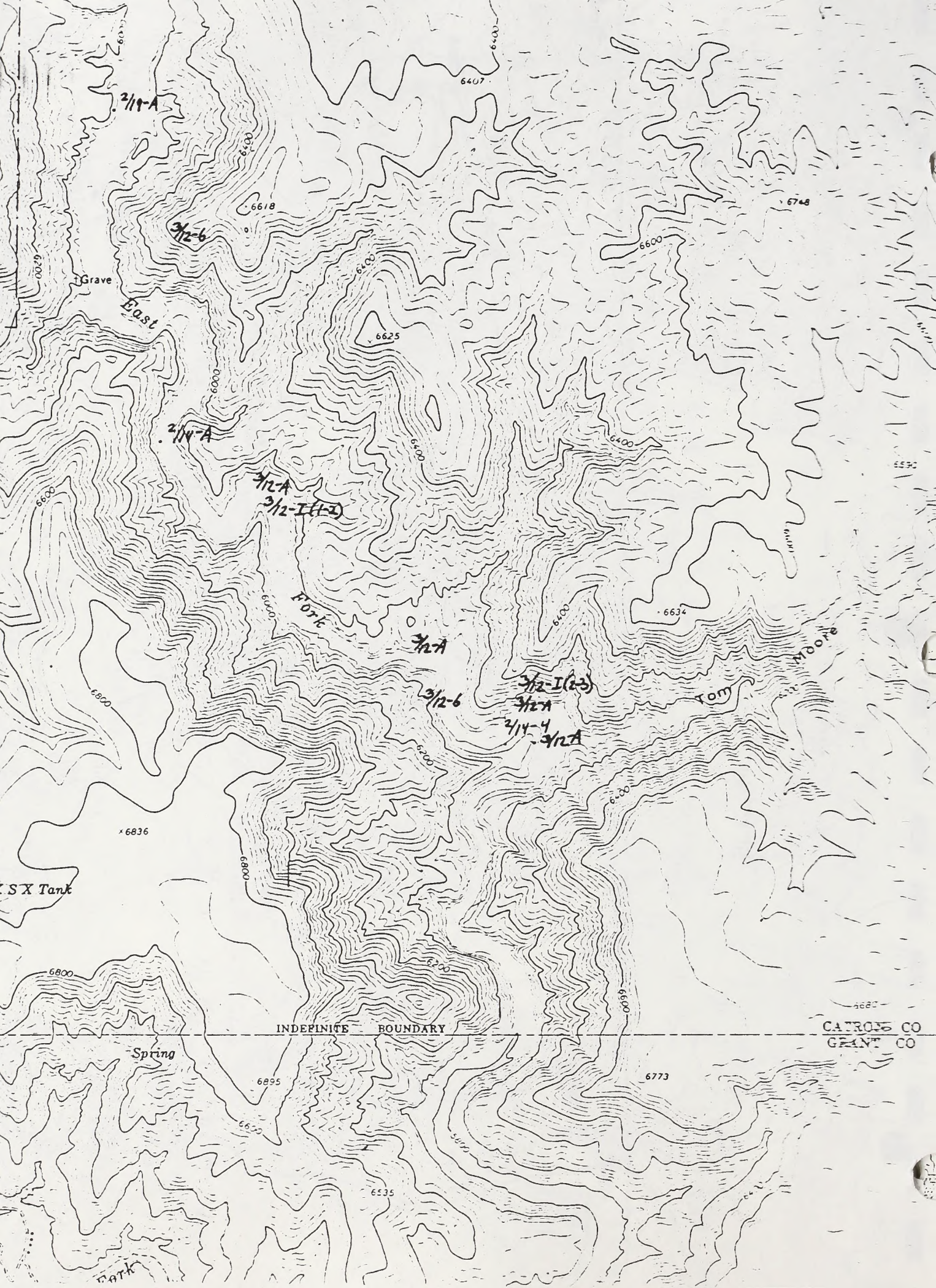
MAP 9 SNOW LAKE
3-8 = eagle perch trees.

MAP 10 CENTERFIRE BOG
1 = pine snag perch, 2 = live pine perch, 3 = observation point. Star = nest tree.

Cliff
Gila
Graveyard Mesa
Fort West
Riverside
Sandy Canyon Tank
Sycamore Spring
Clark Canyon
North Sycamore Mesa Tank
South Sycamore Mesa Tank
Big Dia Windmill
Greenwood Canyon
Spring Canyon
Schoolhouse Canyon
Mangas
Little Black Mtn
Canyon
Pope
Bear
Northrup
ROOST GROVES
CARCASS
OBSERVATION POINT



Spring
Corral
Canyon
Spring
West
6701
6836
X S X Tank
Mesa Spring
6570
6800
INDEFINITE BOUNDARY
G I L A
Spring
Spring
5709
Landing Strip
Springs (Hot)
Grave
Gila Hot Springs
Fork
6380
6048
5616
5
X N X Ranch
East
Grave
N A T I O N A L
F O R E S T
Fork
6395
6535
6773
Grave
X S X Corral
5814
6478
6562
BLACK CANYON

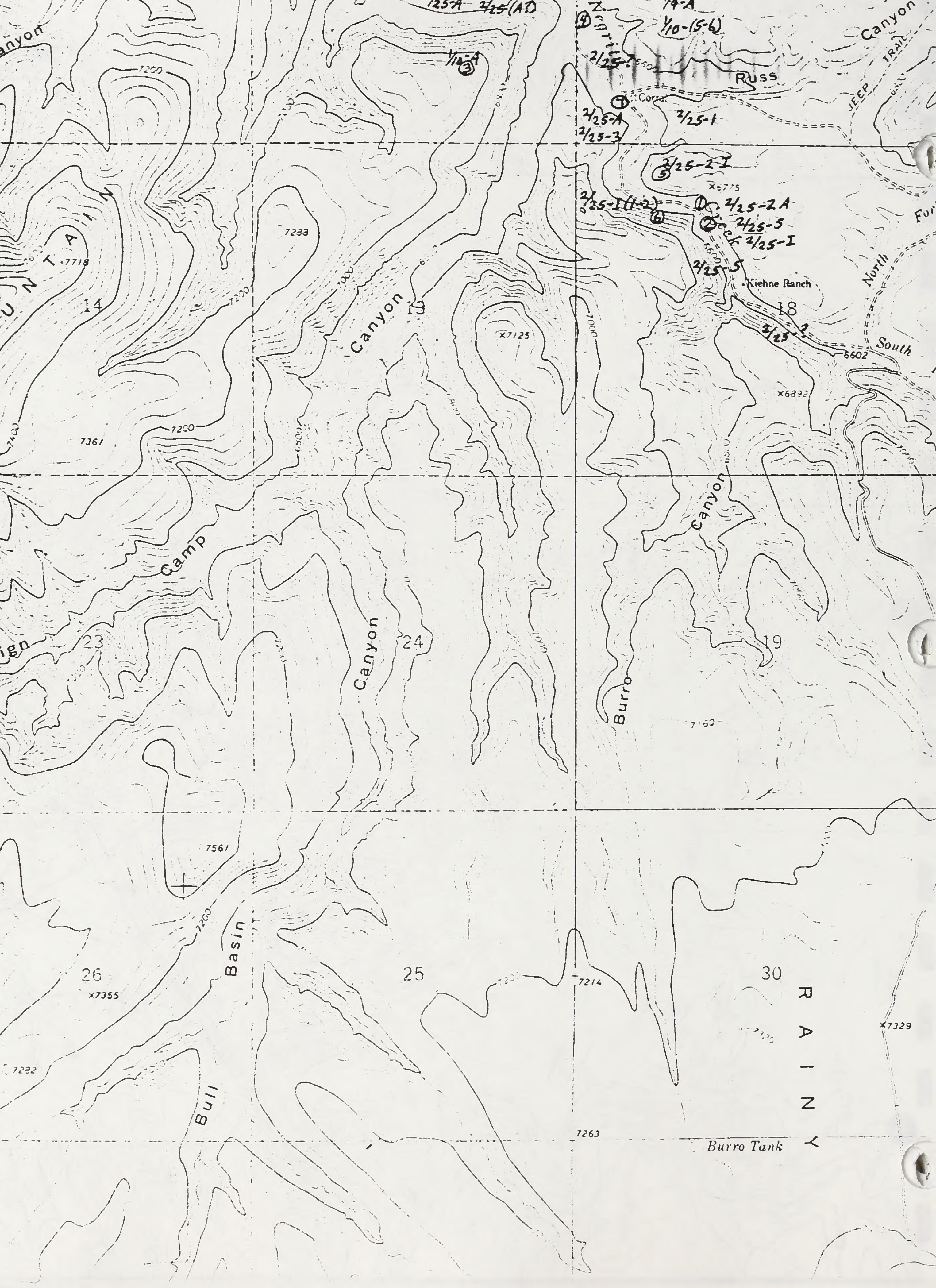


2/19-A
6407
6400
6618
3/12-6
6748
6600
Grave
East
6625
6000
2/14-A
6400
3/12-A
3/12-I(1-2)
6600
Fork
6634
3/12-A
Moore
3/12-I(2-3)
3/12-6
3/12-A
Tom
2/14-4
3/12-A
6800
6200
6400
6836
6800
S X Tank
6800
6200
6600
INDEFINITE BOUNDARY
CATRON CO
GRANT CO
Spring
6895
6773
6600
6535
Fork

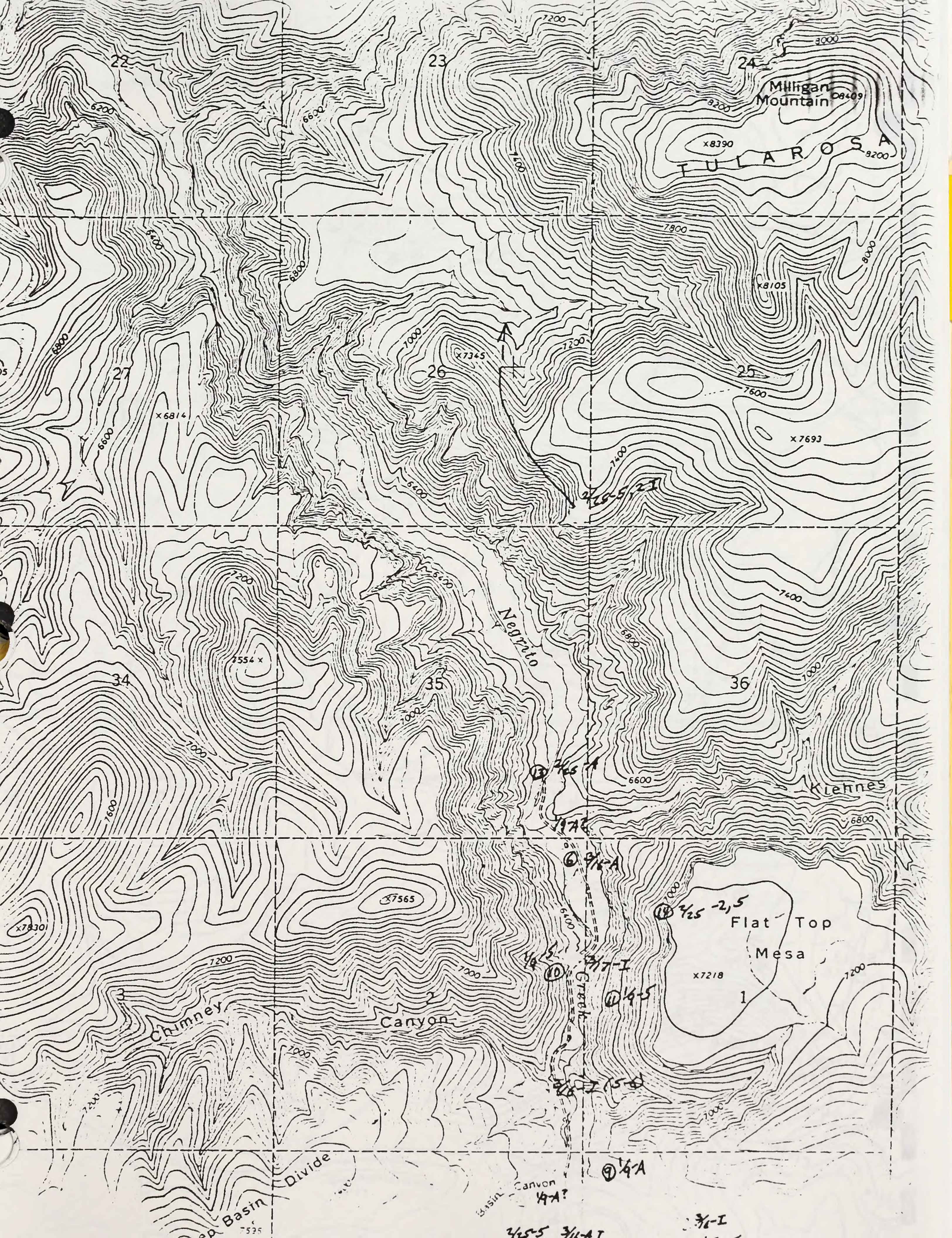
FOREST
No Permit Tank
Rock Bottom Tank
Burnt
Corral
Trap Spring
Fall Spring
35
36
25
T11S
T12S
R13W
R12W
2/19-A
Cement Tank
Canyon
Canyon
River
BM 6523
3
2
1
3/8-A
3/8-I(5)
House Spring
Trail End Ranch
BM 6080
Cem
Gila
2/19-A
3/8-A
Fork
East
2/19-A
2/19-A
3/8-A
3/8-A
3/8-A
10
11
BM 6465
6512
6502
3/8-A
2/19-5
3/8-A(6)
Diamond
Creek

C.C.C. Canyon
2/18-3A
20
21
22
Gila
East
Fork
Steeple U Ranch
29
28
27
Knife Tank
N A T I O N
32
33
34
Creek
BM 6447
BM 6538
6400
6600
6800
6567
6281
6190
6200
6339
6502
6786
6836
6890
6921
6522
6907
6782
6533
6742
6697
6601
6584
6677
6736

Kemp
Canyon
JEEP TRAIL
Prospects
Undertaker Tank
Taylor
Spring
Whitewater
Canyon
Creek
Wall Lake
Campground
Taylor
Creek
Creek
Beaver
Corral
Canyon
5
4
3
2
8
9
10
11
17
16
15
14
BM
6637
BM
6420
BM
6474
61
2/18-A
3/4-A
2/18-3



Canyon
7200
7718
14
7288
Canyon
13
x7125
Russ
Corral
JEEP TRAIL
Kiehne Ranch
North
18
South
6602
x6832
7361
7200
Camp
Canyon
23
Canyon
24
19
Burro
7561
Basin
26
x7355
25
7214
30
RAINY
x7329
7282
Bull
7263
Burro Tank


22
23
24
Milligan Mountain
8409
8390
TULAROSA
8200
8000
7800
8105
7345
7200
7000
6800
6600
27
26
25
x6814
7600
x7693
7400
Negrito
7554
34
35
36
6600
Kiehnes
6800
7565
x7830
Flat Top
Mesa
x7218
3
2
1
Chimney
Canyon
Creek
Divide
Basin
Canyon

AQUEDUCT
x7861
7962
7935
7880
10
11
x8012
Tank
T Bar
Show
16
③ 1/6-2A
15
14
1/7-I
8370
x8423
N A T I O N A
23
7546
x7561
x7654
Reed Tank
7548
⑦ 1/7-I(3-4)
x7502
NOW
LAKE
⑧ 1/7-A
1/6-A
④ 1/7-1
1/7-2A
⑤ 1/6-I(3-4)
Dipping Vat Tank
⑥ 1/7-A
Gaging Sta
Creek
8081
7831
7959
x8132
x7958
Tank
7400
7600
7800
8000
8200

Canyon Well
7287
Miner Tank
Miner Wel
Spur
Lake
NATIONAL
Canyon Tank
Dry Tank
30
28
1/4-A
1/4-A
1/4-A
1/4-A
Draw
JEEP
TRAIL
BM 7175
31
32
33
Creek
Deadman Tank
Centerfire Bog
1/4-A
2/8-A
1/4-A
1/4-A
Centerfire
5
4
1/5-A
Upper
Cottonwood
Cottonwood

APPENDIX I

BALD EAGLE HABITAT STUDY
WINTER RANGE

REQUIREMENTS

Scope of Work

To conduct a study of habitat requirements for wintering Bald Eagle within selected concentration areas on the Gila National Forest.

Objectives

1. To determine characteristics of suitable habitat being utilized for roosting, perching and hunting activities.

2. To determine variations in eagle habitat use between lake/pond and riverine habitat.

3. To determine habitat use variations as affected by movements stimulated by impoundment freezing, high water runoff, disturbance factors, etc.

4. To determine quantative food habits, waterfowl, fisheries, mammals, carrion, and hunting methods utilized.

5. To determine riparian vegetation types and tree densities preferred by riverine birds.

6. To determine any possible territorial behavior and territorial habitat area size where present.

7. To survey for possible (March-early June) nest sites within selected areas. To compile information, and make recommendations concerning habitat management for populations of wintering Bald Eagles on the Gila National Forest.

Reports

To provide an Interim Report consisting of a summary of your basic winter range findings to this office by March 1, 1979.

To provide fifteen (15) copies of your Final Report on the individual objectives, as described above, to this office by August 31, 1979.

The Contractor shall furnish all labor, transportation, superintendence, equipment, printing and supplies to perform this study.

Program Time

Study to commence January 1, 1979 and shall continue until receipt of official bound copies (15) on or before August 30, 1979.

3

4

1

2

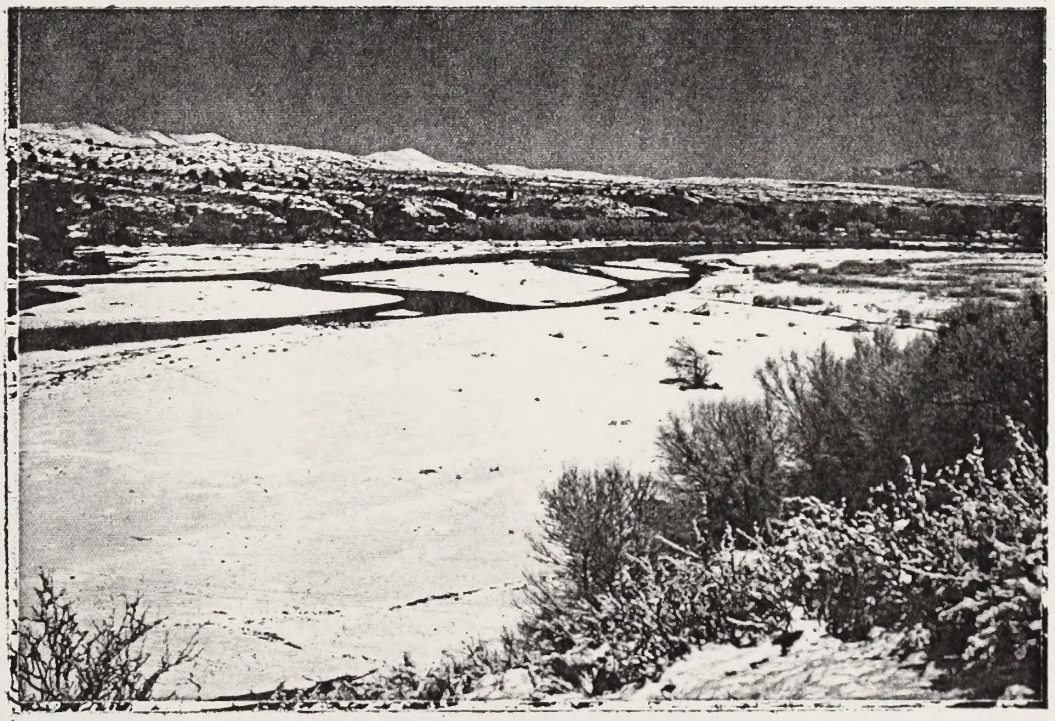


PHOTO I

A favorite perch in the area of high eagle use seven miles south of Cliff (SE 1/4, NW 1/4, NW 1/4, Sec. 3, T 7 S, R 17 W). This dead cottonwood stands above a cut-bank at the east edge of the Gila River, across the river from the roost groves.

PHOTO 2

High eagle use area seven miles south of Cliff. View is from our observation point. The hog carcass was on the gravel bar just right of island in right-center of photo.

PHOTO 3

Driftwood eagle perches in bed of Gila River seven miles south of Cliff. Roost groves in background. The large, forked limb protruding from gravel in left center was a favorite perch, where up to 4 eagles perched at a time.

PHOTO 4

Hog carcass and a much-used log perch on east bank of the Gila River seven miles south of Cliff.

APPENDIX 2

STUDY PLAN--BALD EAGLE SURVEY IN GILA NF

TIMETABLE

Field work dates:

Jan. 1--Jan. 14	Gary Falxa and Dirk Lanning
Feb. 5--Feb. 19	Devora Ukrain and David Whitacre
March 1--March 14	Roger and Kate Skaggs

Breeding survey: Between April and June 15, as deemed appropriate after literature review and contacts with knowledgeable individuals. Survey will entail 14 days of field work within this period, by two observers.

METHODS

Based primarily on information about eagles' whereabouts obtained from prior aerial surveys of other workers, USFS personnel, and one or two flights by us, we will select two lake or pond and two river or stream sites, in which to do intensive observations of eagle behavior, diet, and habitat use, response to weather. In large part, information gained in this way will satisfy objectives 1, 2, 3, 4, 5, and 6 of the Request (R3-6-79-2N).

In addition, record as many behavioral and habitat parameters as practicable on a standard data sheet, for all eagle sightings in the GNF made by us during our field work.

For two intensive lake study sites and two intensive river study sites, quantify habitat features important to Bald Eagles, emphasizing prey and perch/roost site availability and quality. Specifically, estimate mean height, dbh classes and density of trees, by species, in important perch or roost stands. Evaluate shelter (as influenced by topography, position of perches in drainage, elevation), human disturbance factor, and potential prey availability. Conduct observations from a blind or blinds if desireable.

For casual eagle sightings, classify community type according to USFS guidelines, and describe other parameters in as much detail as is practical.

Provide photographic documentation of general features and specific features important to eagles in the four intensive study areas. Provide photos of any features of casual sighting localities which illustrate some feature of Bald Eagle ecology particularly well.

TRANSPORTATION

We anticipate some difficulty in reaching eagle concentrations at high elevations and at the ends of bad roads or long trail or trail-less sections. Reach easy access concentrations by means of 2WD (Volkswagen Bug or Bus), and more difficult access areas by means of 4WD (Dodge Powerwagon). Where necessary, hike by means of snowshoe or skiis to intensive study sites.

Probably, camp at intensive study sites, especially if access is difficult.

METHODS, BREEDING SURVEY

Visit localities of possible nesting, as determined by USFS and other knowledgeable local residents, at least once during breeding season (as determined by literature search, probably between 1 April and 15 June).

Observers:_____ Date:_____ Time:_____

Eagles Observed:___Adults,___Immatures(__year). Activity:_____

Location:_____

Legal Desc: ¼of ¼s. T R .Elev:_____ft. (Sketch area map & tree on back)

Weather: Snow cover:

TERRAIN. Slope:_____°. Aspect/Exposure:_____. Wind Protection: none,some,sheltered.

General Topog. of surr. area:_____

_____

_____ __. Cliff perch:___ft. below top of ___ft. cliff.

VEGETATION Species composition (sp./ %)_____

_____

Coniferous/Deciduous ratio_____. Continuity: continous,broken(openings >50%),isolated

No. of trees if countable_____. Crown density: ____%. Snags:(No./ %)_____

Regeneration of roost/perch trees: evident, absent, undetermined.

ROOST/PERCH TREES Species:_____ Height:_____DBH: _____

Location in stand:_____

Condition: 1. all dead, top intact 2. all dead, top broken 3. living, top broken
4. living, top intact but dead 5. all living, top intact 6._____

Branch location in crown: Upper 1/3, Middle 1/3, Lower 1/3

Perch location on branch: Outer 1/3, Middle 1/3, Inner 1/3

View from perch_____

Castings or Mutes:_____

WATER Name:_____ Distance and direction from tree_____

Ice cover: (%)_____ Level: low, normal, high. Stream Flow: still, slow, fast.

Beach: rocky/sandy, boulders, cliff/canyon, overgrown vegetation, frozen over.

DISTURBANCE FACTORS (houses, roads, human activity, sound)_____

_____

_____

POTENTIAL PREY AVAILABLE_____

OTHER RAPTORS (sp. and nos.) _____

AVIAN AND

APPENDIX 4

POTENTIAL BALD EAGLE PREY OBSERVED AT SELECTED SITES

LAKE ROBERTS 1 Jan.--partly frozen--a few ducks.
4 Feb.--10-20 % frozen--3 great blue herons, 1 belted kingfisher, ca. 120 waterfowl, including: 3 pied-billed grebes (Podilymbus podiceps), 6 mallards, 2 ring-necked ducks (Athya collaris), 2 scaup (Aythya sp.), 6 buffleheads (Bucephala albeola), ca. 15 ruddy ducks (Oxyura jamaicensis), 60 + common mergansers, 2 American coots (Fulica americana).
8 Feb.--80 % frozen--ca. 60 waterfowl, mostly common mergansers.
16 Feb.--ice status ?--1 great blue heron, 1 gull sp., 121 waterfowl, including: 5 pied-billed grebes, 6 mallards, 3 goldeneyes (Bucephala clangula), 5 buffleheads, 10 ruddy ducks, 91 common mergansers, 1 American Coot.

WALL LAKE 17 and 18 Feb.--15 % frozen--1 great blue heron, 1 killdeer (Charadrius vociferus), 69 waterfowl, including: 8 pied-billed grebes, 4 mallards, 4 American widgeon (Mareca americana), 8 green-winged teal, 1 canvasback (Aythya valisineria), 26 ring-necked ducks, 2 scaup, 4 common goldeneyes, 1 common merganser, 11 coots.
7 March--no ice?--1 great blue heron, 2 killdeers, 22 waterfowl, including 3 pied-billed grebes, 3 mallards, 4 green-winged teal, 4 common mergansers, 8 coots.

SNOW LAKE 6 Jan.--80-85 % frozen, melting--muddy, visibility two inches.--3 great blue herons, 1 belted kingfisher, 60 waterfowl, including: 31 mallards, 3 ring-necked ducks, 20 + common mergansers.
8 Feb.--100 % frozen--no waterfowl.
26 Mar.--0 ice--waterfowl ?
13 April--0 ice--ca. 30 waterfowl, mainly coots.

BILL EVANS LAKE 5 Feb.--less than 5 % frozen--1 gull sp., 65 waterfowl, including: 1 pied-billed grebe, 12 Scaup, 11 common mergansers, ca. 40 coots (only ca. 1/2 of lake was censused).
22 Feb.--0 ice--9 olivaceous cormorants (Phalacrocorax olivaceus), 3 great blue herons, 97 waterfowl, including: 4 redheads (Aythya americana), 17 scaup, 3 goldeneyes, 4 common mergansers, ca. 60 coots. (entire lake censused).

CENTERFIRE BOG 4 Jan.--100 % frozen--no waterfowl.
8 Feb.--95-98 % frozen--no waterfowl ?
31 Mar.-1 April--no ice?--201 waterfowl and shorebirds, including: 3 pied-billed grebes, 8 mallards, 4 American widgeon, 2 blue-winged teal (Anas discors), 35 cinnamon teal, 8 green-winged teal, 4 ring-necked ducks, 18 ruddy ducks, 112 coots, 1 greater yellowlegs (Totanus melanoleucus).

LUNA LAKE 31 March--10-20 % frozen--ca. 1000 waterfowl.
12-13 April-ice status ?--900-1000 waterfowl, including 600 + coots.

U BAR T LAKE 23 March--ice status ?--33 waterfowl, including: 3 mallards, 3 American widgeon, 20 green-winged teal, 2 buffleheads.

Following is a rough index of the abundance of prey along several river and creek segments. Not every coverage was identical with respect to the hours spent and miles of waterway traversed.

UPPER EAST FORK, GILA RIVER 18 Feb.--11 mallards, 1 pintail
19 Feb.--4 mallards, a few fish.

LOWER EAST FORK, GILA RIVER 14 Jan.--8 mallards, no fish.
14 Feb.--2 common mergansers, 3 ducks, no fish.

11 March--4 mallards.
12 March--3 common mergansers.

LOWER BEAVER CREEK 24 March--many 6-12 inch suckers, bullfrogs and a garter snake.

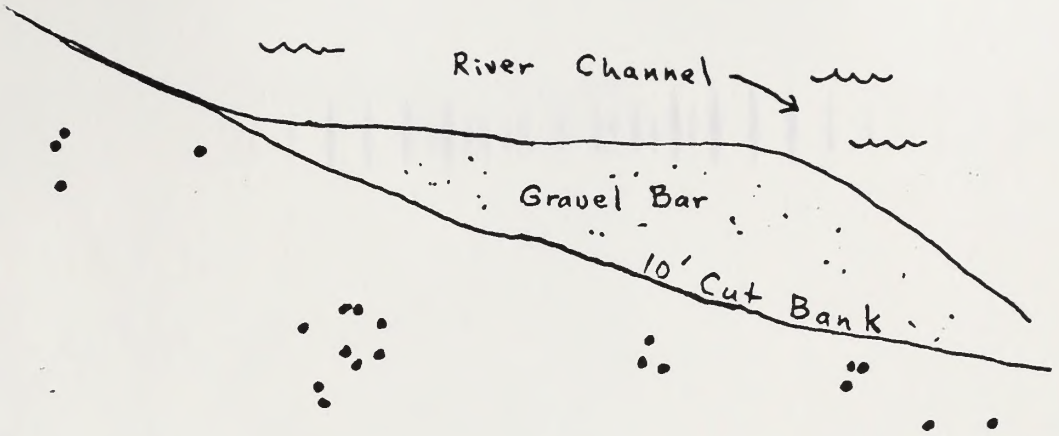
LOWER NEGRITO CREEK 11 Jan.--no fish or ducks.
26 Feb.--no fish or ducks.

UPPER NEGRITO CREEK 9 Jan.--1 snipe, 1 kingfisher, several dippers, 2 ducks.
10 Jan.--no fish.
25 Feb.--no fish or ducks.
16-17 March--no potential prey noted.

GILA RIVER SEVEN MILES BELOW CLIFF Feb.--an occasional one or two common mergansers.

APPENDIX 5: DATES OF OBSERVATIONS

Centerfire Bog--	4, 5 Jan., 20, 21, 21 Mar., 1 April
Negrito Creek --	9, 10, 11 Jan., 24, 25, 26 Feb., 16, 17 Mar.
S. Fk. Negrito Creek --	24 Feb.
Snow Lake --	6, 7, 8 Jan., 13, 14 April
Wall Lake, Upper E. Fk. etc.	17-21 Feb., 7-9 Mar., 23-25 Mar.
Lower E. Fk. --	14, 15 Jan., 13-15 Feb., 11-13 Mar.
Lake Roberts --	4, 16 Feb.
Gila River 7 mi. below Cliff-	5-7, 10-12, 22 Feb.
Luna Lake --	31 Mar., 13-14 April
Middle Fk. Gila below Snow Lake-	13, 14 April



North Grove

Lone Cottonwood

Appendix 6. Map of Bald Eagle Roost Groves on Southwest Bank of Gila River Seven Miles South of Cliff, New Mexico. Made by Compass and Pacing, 11 Feb., 1979. Terrain is Level.

magnetic north

50 Feet
(¼ inch = 10 feet)

South Grove

300 feet

East Grove

PHOTO 5

Roost groves on west bank of Gila River, seven miles south of Cliff. View is from east bank of river. Lower tier overlaps righthand edge of upper tier. Tall cottonwoods in the righthand end of the lower tier were the favorite roost trees, but others were used as well.

PHOTO 6

Bald eagle in a favorite roost tree at north end of roost seven miles south of Cliff. Its perch position within the tree is typic 1.

PHOTO 7

Three cottonwoods in high eagle use area seven miles south of Cliff. The tree at left is the same one pictured in Photo 1, and was the only one of the three used by eagles. It has many stout, dead horizontal limbs without interfering twigs. The other two trees are living, and have too many small limbs and twigs to permit eagles access to larger limbs.

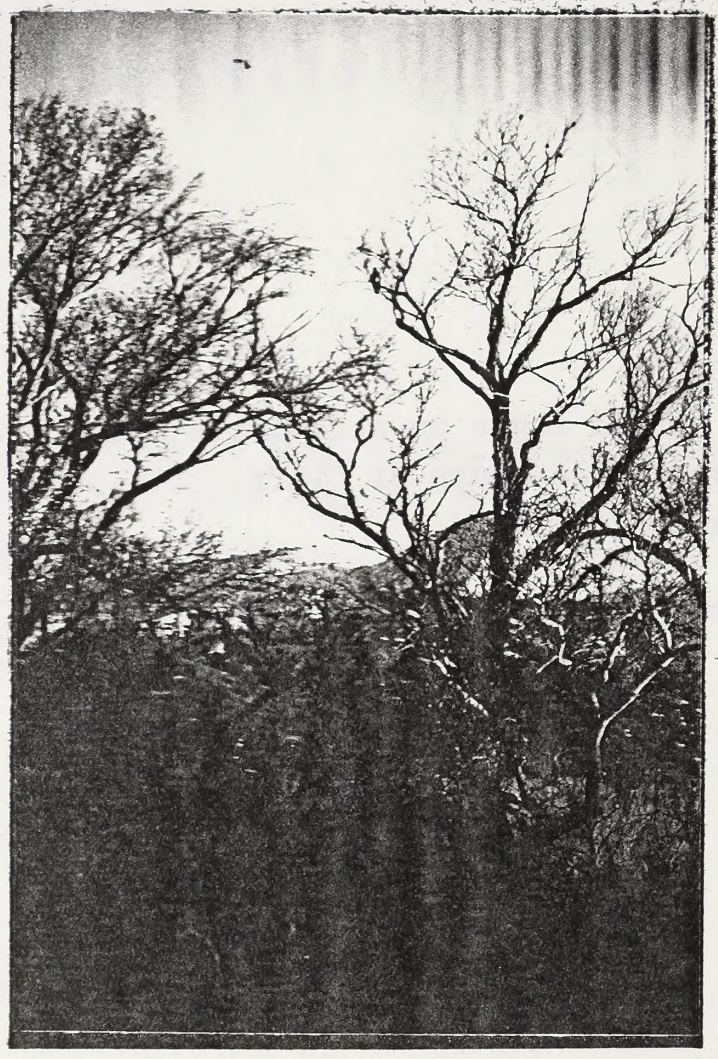


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PHOTO 8

A dead ponderosa pine eagle perch along blacktop road just west of Lake Roberts General Store. This perch was unusual in being located so close to a well-traveled road and several human dwellings.

PHOTO 9

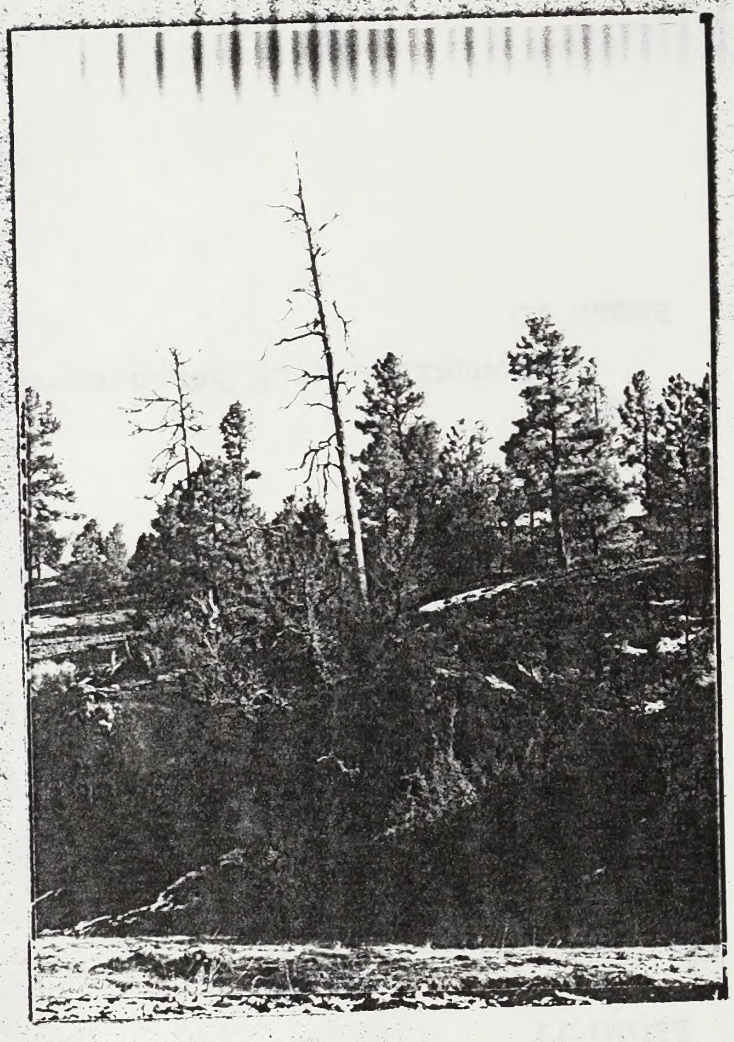
Ponderosa snag perch tree at SE edge of Wall Lake.

PHOTO 10

A ponderosa snag perch along the East Fork of the Gila River.

PHOTO 11

A hawthorne (?) perch along the East Fork of the Gila River. This tree, only 25 feet tall, is on a steep bank about 50 feet above the river.



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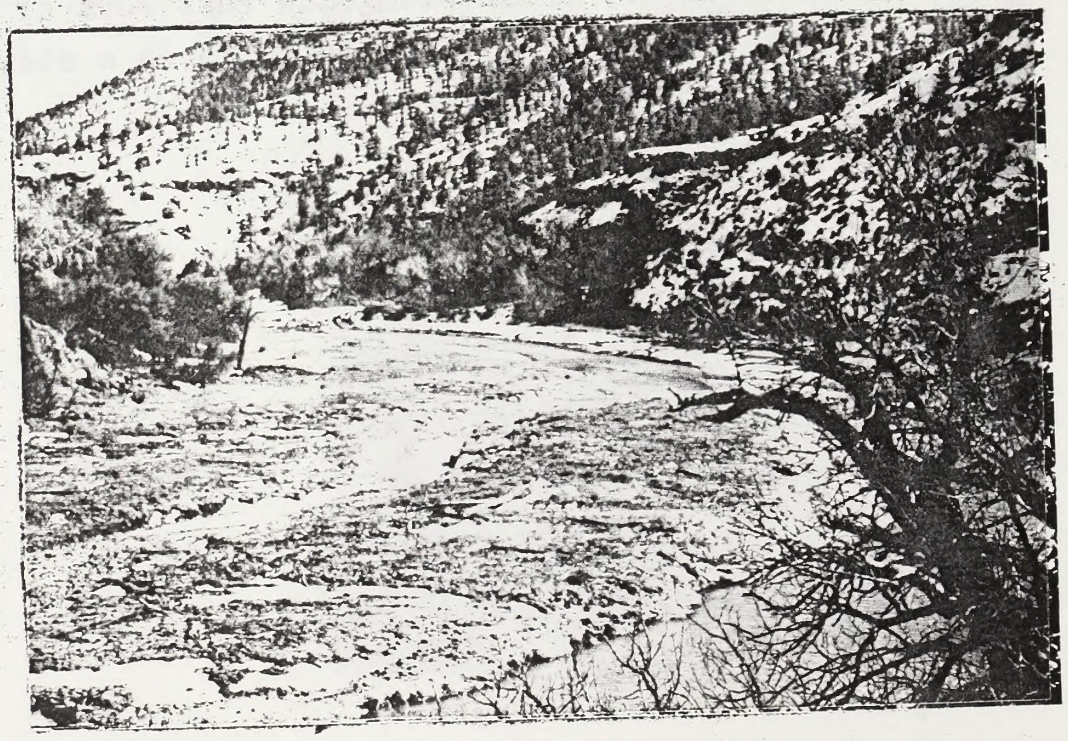

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PHOTO 12

Ponderosa snag perch along the east fork of the Gila River, where four year old eagle was perched, looking down toward the river, presumably for fish or other aquatic prey.

PHOTO 13

Same tree as photo 12, looking upstream from hillside.

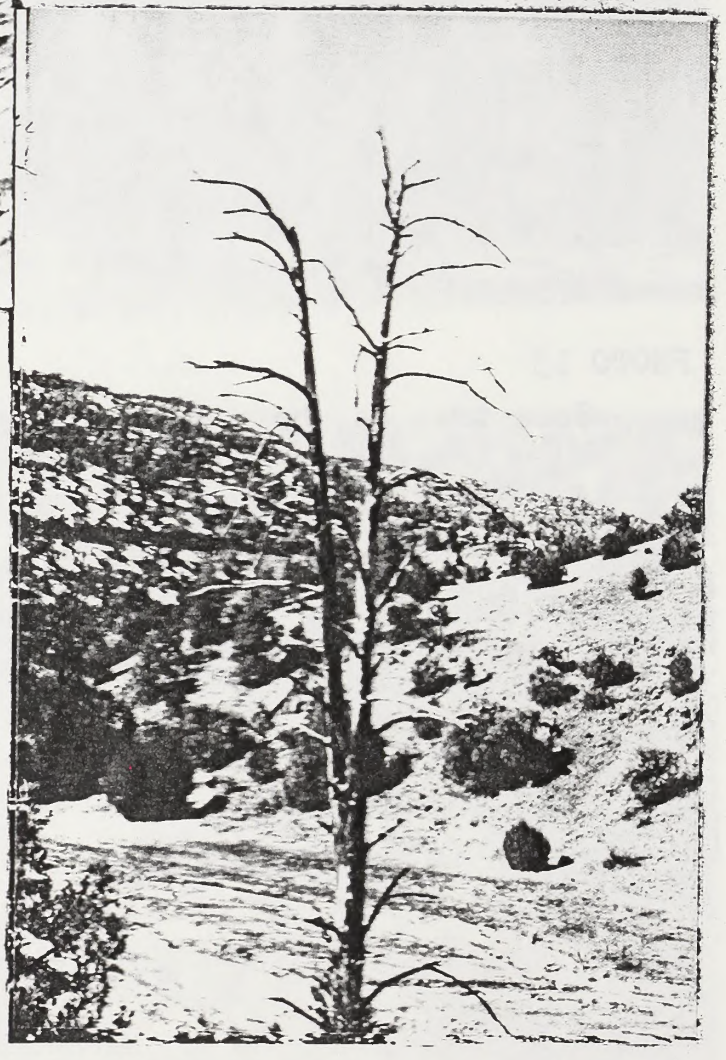

PHOTO 14

Ponderosa snag perch along East Fork of the Gila River.

PHOTO 15

Pine snag perch along Negrito Creek. This perch was unusual in being located high above the creek.

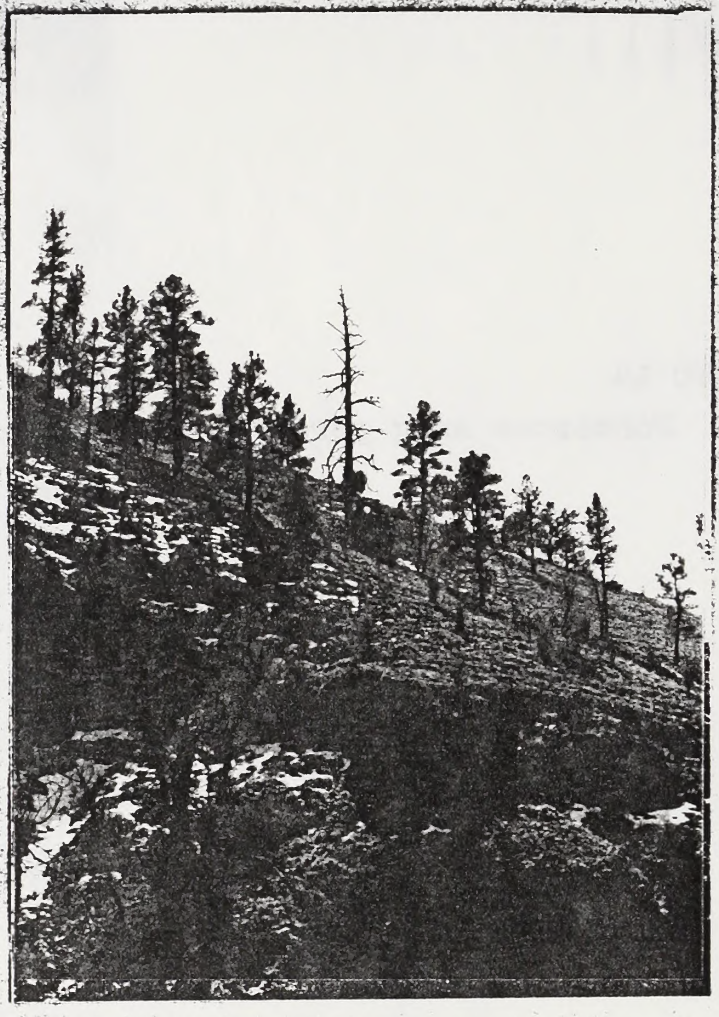

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PHOTO 16

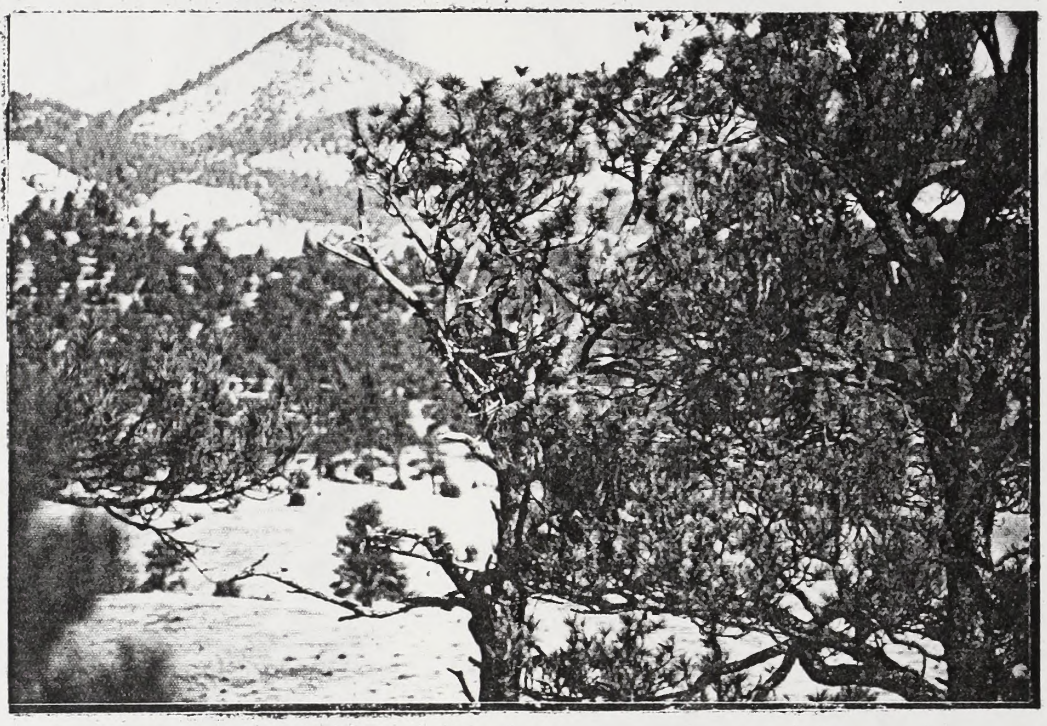
Panorama of Centerfire Bog, looking eastward from the west side of bog. Lower tier overlaps righthand edge of upper tier.

PHOTO 17

Bald eagle on nest at Centerfire Bog.

PHOTO 18

Stillborn calf on grama bench above East Fork of the Gila River. Note evidence of heavy grazing.



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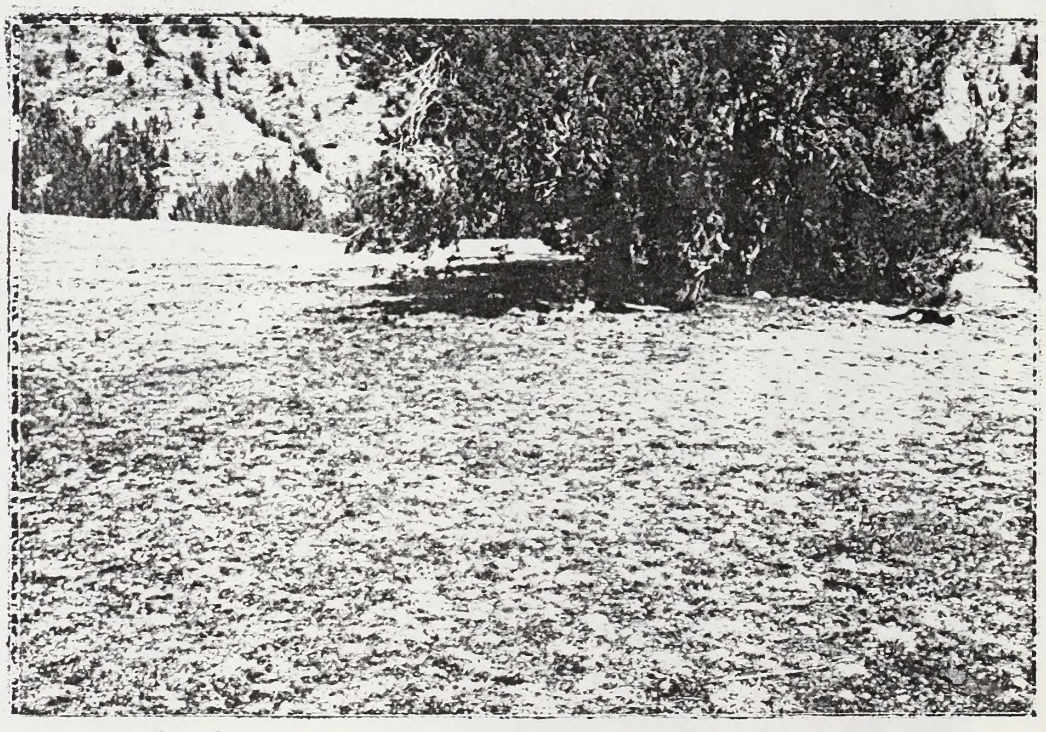

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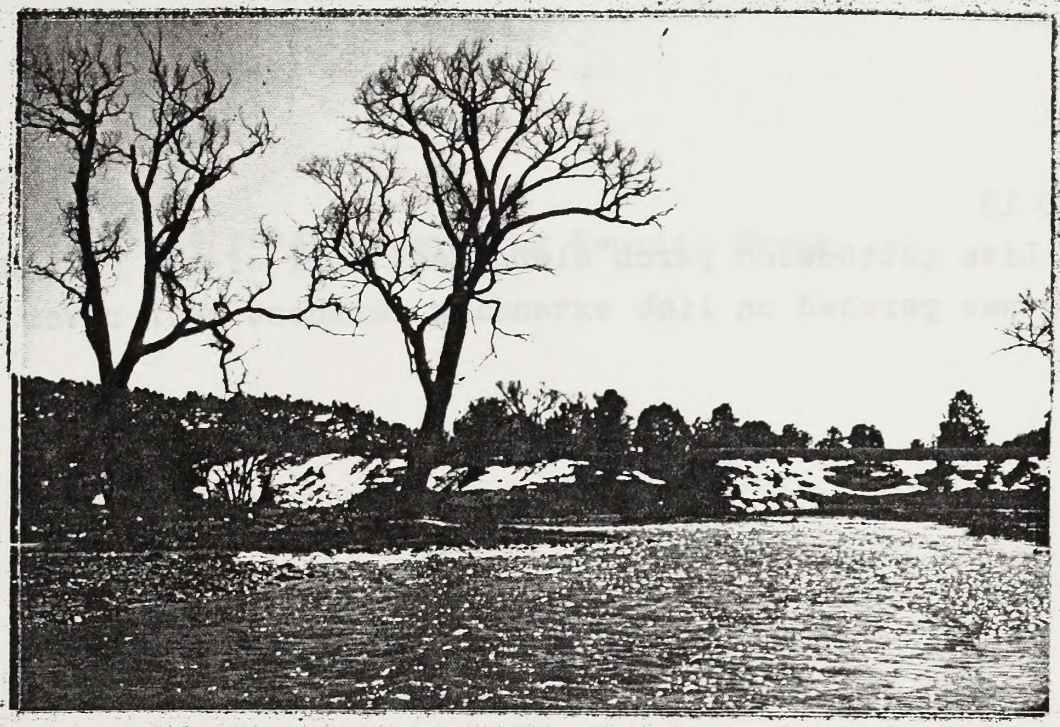

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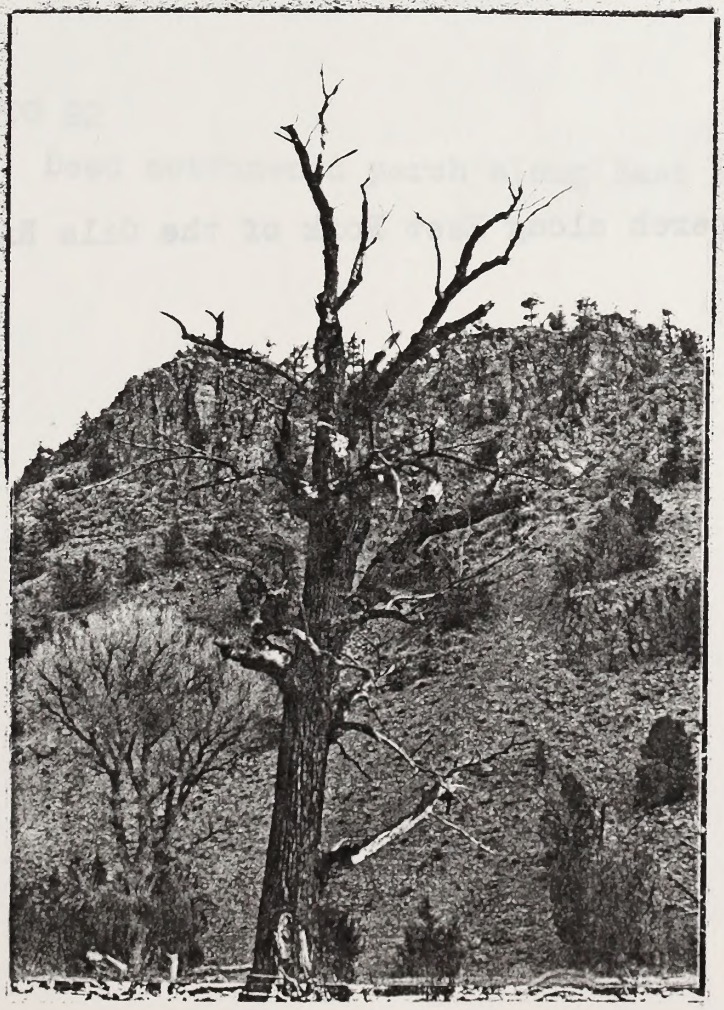


PHOTO 19

Live cottonwood perch along East Fork of the Gila River. Eagle was perched on limb extending farthest over river.

PHOTO 20

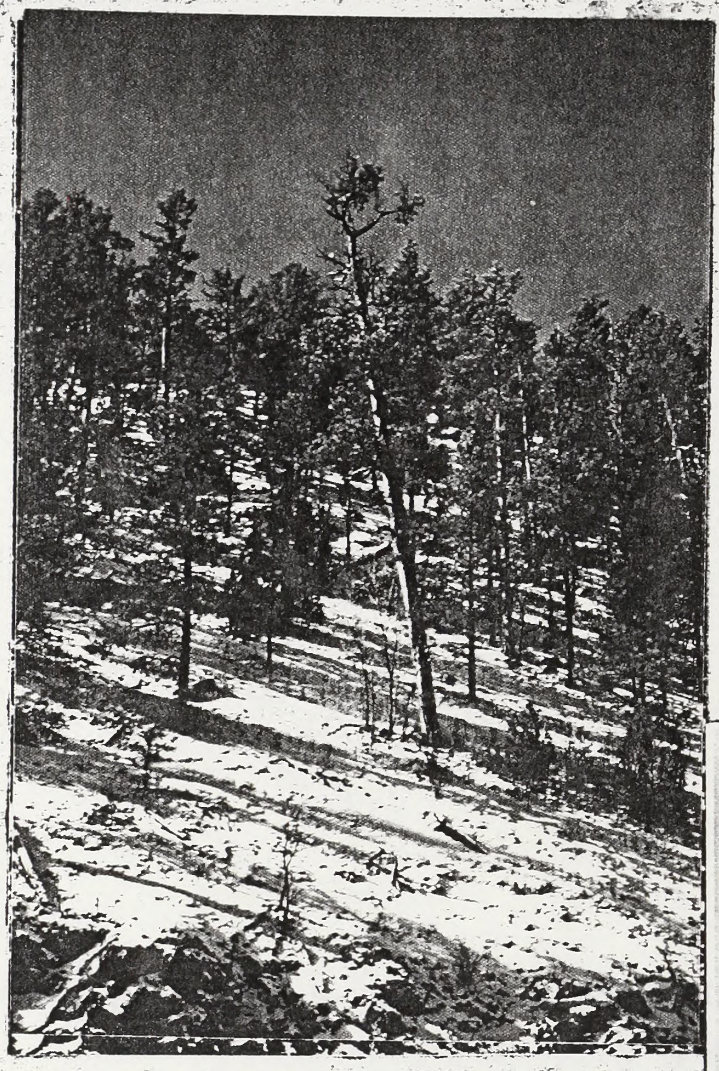
Dead cottonwood perch along East Fork of the Gila River.

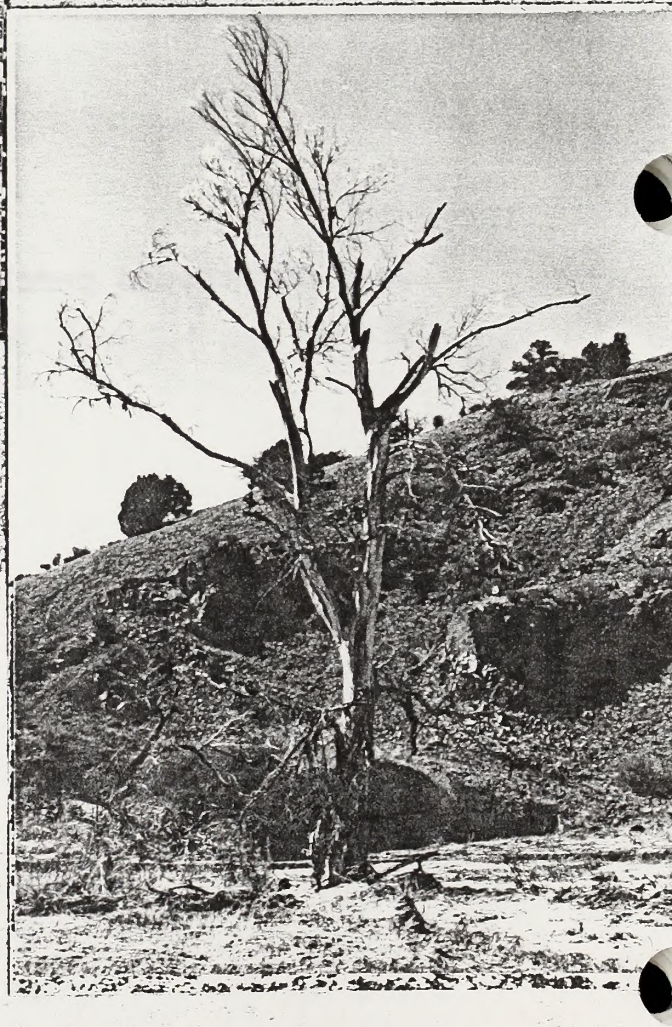
PHOTO 21

Probable roost tree along Negrito Creek.

PHOTO 22

Dead cottonwood perch along East Fork of Gila River.





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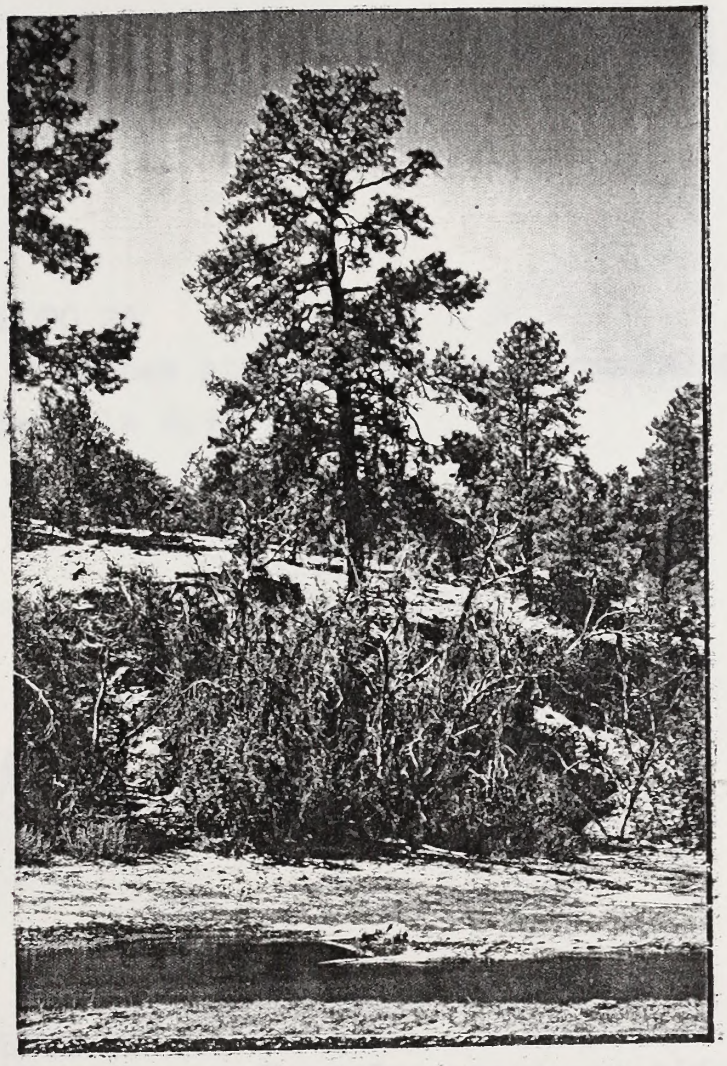

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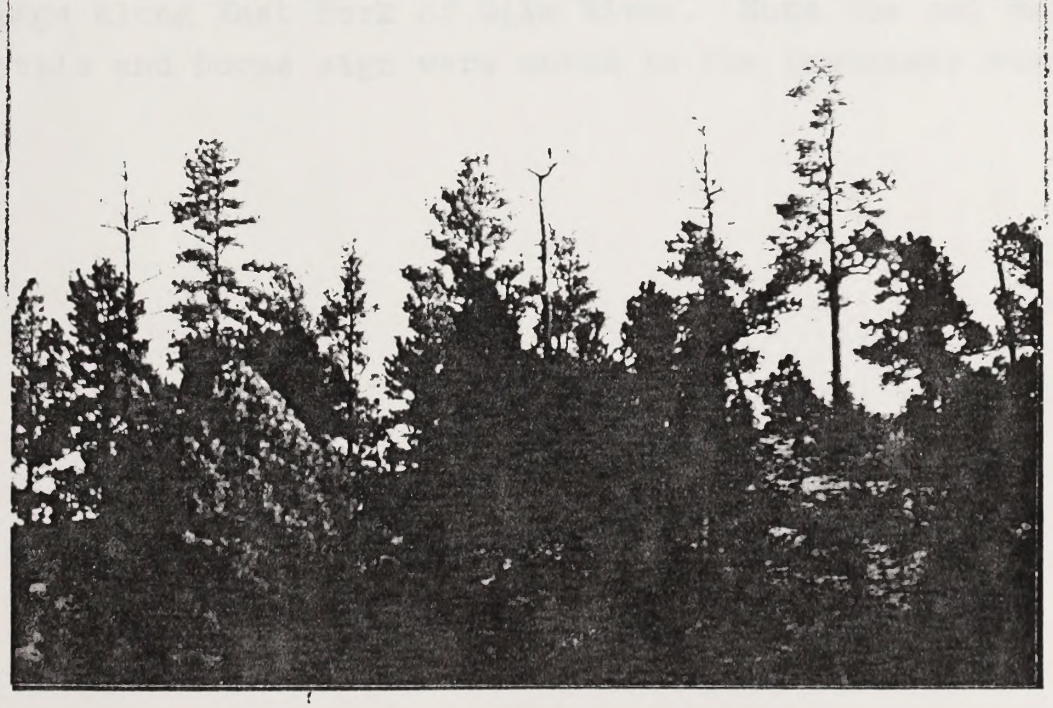

PHOTO 23

Probable roost tree along Beaver Creek.

PHOTO 24

Bald Eagle in probable roost tree along Negrito Creek.

PHOTO 25

Dense stand of young cottonwoods along east fork of the Gila River.

PHOTO 26

Evidence of browsing on cottonwood and/or willow saplings along East Fork of Gila River. Note the cut ends. Cattle and horse sign were noted in the immediate vicinity.

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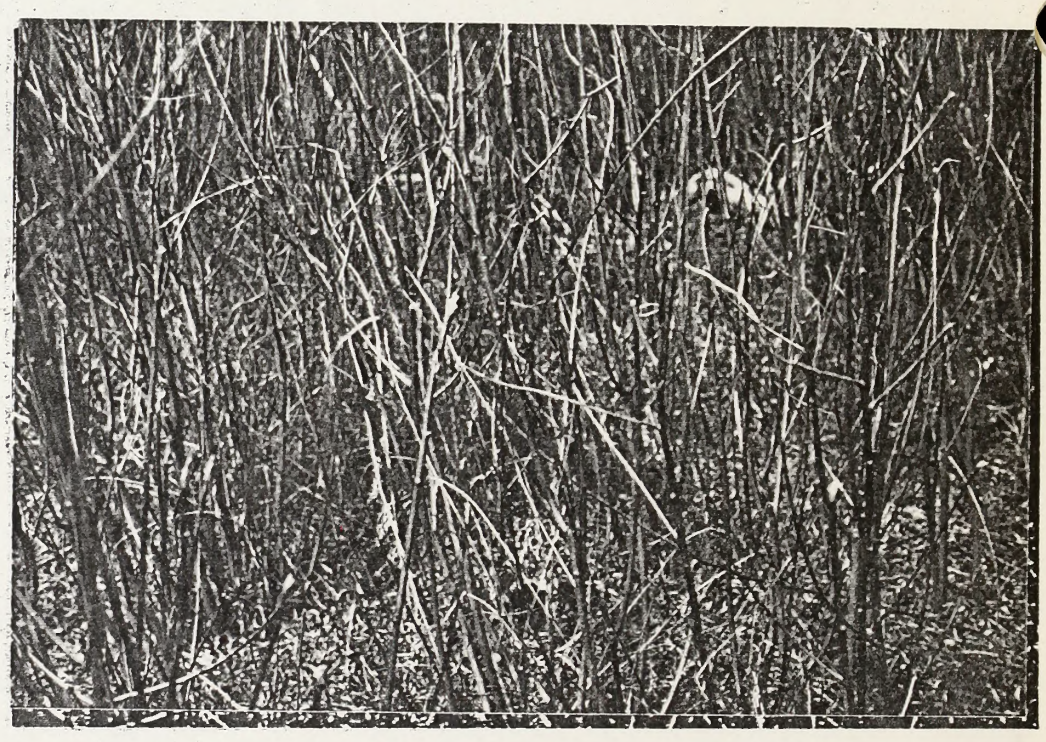

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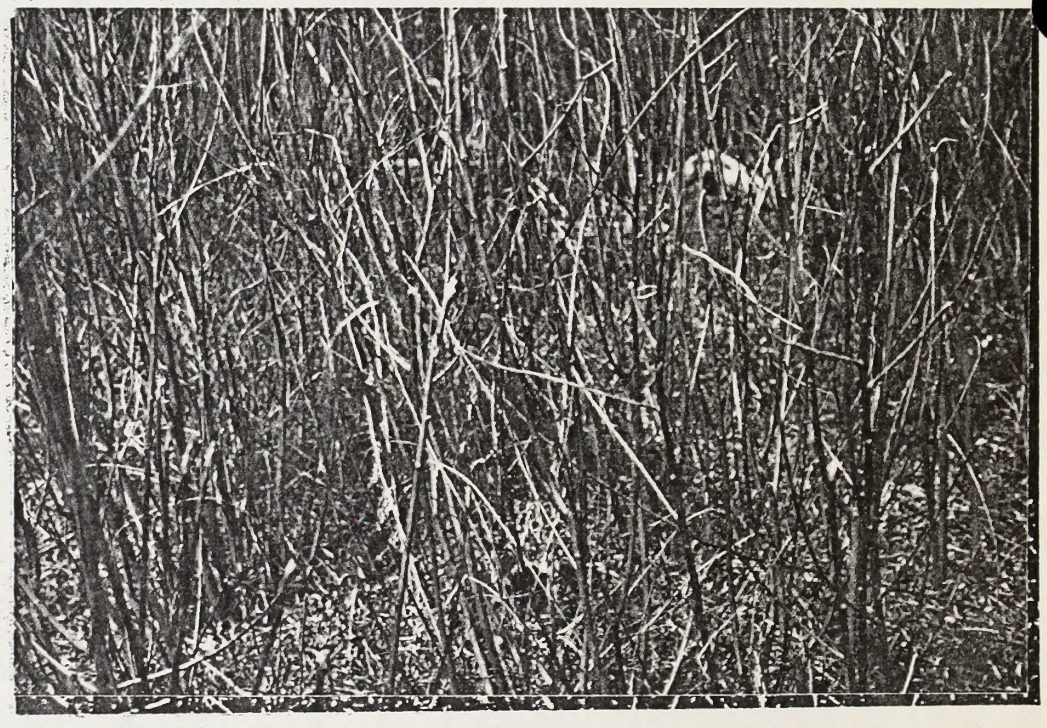

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AERIAL SURVEYS

AERIAL SURVEY NOTE

The following reports document the aerial surveys conducted by the New Mexico Department of Game and Fish in November 1978 and January 1979. A third survey was flown in April with funding from the BLM-RMS Interagency Agreement. There is no interim report for this survey, which covered the northern half of the state, including Navajo Lake, and portions of the San Francisco and Blue drainages. The southwestern, Gila country was not flown due to poor weather conditions. No bald eagles were seen during the April flights. (John Hubbard, pers. comm.) The results of all three surveys are being compiled into one report, which will be made available to the BLM and RMS upon its completion.

NORTHERN NEW MEXICO BALD EAGLE SURVEY (N.M.G.F.)

29-30 November 1978

NORTHEASTERN: 7:15 a.m. to 3:48 p.m., 29 November 1978 (see map)

Observers: Dick Brown (pilot), John Hubbard, Mike Hatch, Jim Vaught.

Weather: Mainly clear, cool to cold, moderate northwest winds; waters frozen at higher elevations, open below 7000 ft.

Survey Data: Cessna Skymaster, covering likely bald eagle areas at ca. 100 mph and 200 ft. altitude.

AREA	Survey Minutes	Bald Eagles Ad.	Bald Eagles Im.	Other Raptors
1. Santa Fe, Canyon (Santa Fe Co.)	3	0	0	0
2. Red-Black Lakes (Colfax Co.)	23	1	0	0
3. Eagle Nest Lake (Colfax Co.)	7	1	0	0
4. Costilla River (Taos Co.)	7	0	0	0
5. Vermejo River (Colfax Co.)	21	2	1	0
6. Maxwell Lakes (Colfax Co.)	13	1	3	2 ad. golden eagles 1 im. golden eagle 1 rough-legged hawk 1 marsh hawk 1 raptor
7. French Lakes (Colfax Co.)	10	3	1	3 red-tailed hawk
8. Upper Cimarron River (Colfax Co.)	12	4*	4	1 golden eagle 5 red-tailed hawks 2 Buteo sp. 1 raptor (large)
9. Miami Lake (Colfax Co.)	6	0	0	2 red-tailed hawks 1 rough-legged hawk 1 Buteo sp.
10. Lower Cimarron River (Colfax Co.)	7	2	0	2 rough-legged 1 Buteo sp. 1 marsh hawk
11. Charette Lakes (Mora Co.)	2	1	0	1 rough-legged hawk 2 Buteo sp.
12. Wagon Mound (Mora Co.)	1	0	0	1 Buteo sp.
13. La Cueva S.G.R. (Mora Co.)	9	6	2	1 Buteo sp.
14. Ft. Union (Mora Co.)	1	0	0	0
15. Cherry Lake (Mora Co.)	3	2	0	1 red-tailed hawk 1 American kestrel
16. Watrous area (Mora Co.)	2	1	0	0
17. York Lakes (San Miguel Co.)	5	3	1	1 red-tailed hawk 1 Buteo sp.
18. Storrie Lake (San Miguel Co.)	3	1	0	1 ferruginous hawk
19. McAlister Lake area (San Miguel Co.)	5	0	0	1 red-tailed hawk 1 prairie falcon 1 red-tailed hawk
20. Bitter Lake NWR (Chaves Co.)	9	0	0	2 rough-legged hawks 4 marsh hawks

*1 subadult

AREA	Survey Minutes	Bald Eagles Ad.	Bald Eagles Im.	Other Raptors
21. Summer Lake area (DeBaca-Guadalupe Cos.)	18	1	2	1 ad. golden eagle 1 golden eagle 1 red-tailed hawk 1 Buteo sp. 2 marsh hawks 1 American kestrel
22. Conchas Lake (San Miguel Co.)	19	0	0	1 marsh hakw
23. Ute Lake (Quay Co.)	20	1*	2	1 Swainson(?) hawk 2 marsh hawks
24. Tucumcari Lake (Quay Co.)	1	0	0	3 marsh hawks
TOTALS	306	30	16	6 golden eagles 15 red-tailed hawks 7 rough-legged hawks 1 ferruginous hawk 1 Swainson(?) hawk 10 Buteo sp. 14 marsh hawks 1 prairie falcon 2 American kestrels 2 raptor sp.

NORTHWESTERN: 7:27 a.m. to 12:22 p.m., 30 November 1978 (see map)

Observers: Same as above

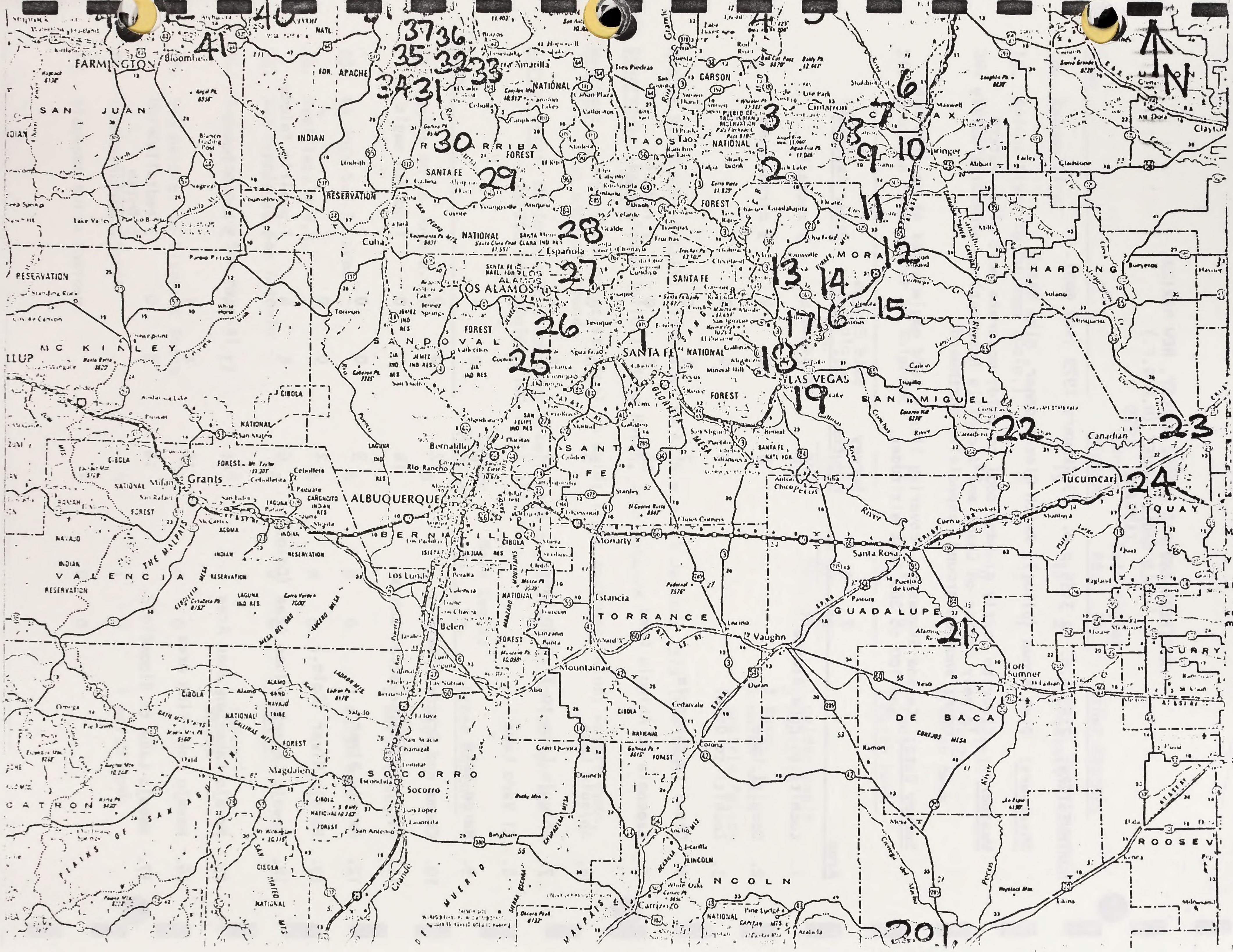
Weather: Same as above, except heavy overcast in upper Chama River and Jicarilla Reservation areas.

Survey Data: Same as above.

AREA	Survey Minutes	Bald Eagles Ad.	Bald Eagles Im.	Other Raptors
25. Cochiti Lake area (Sandoval Co.)	5	1	2	1 red-tailed hawk 1 Buteo sp.
26. White Rock Canyon (Santa Fe Co.)	26	0	0	0
27. Rio Grande--Otowi Bridge to Espanola (Santa Fe-Los Alamos cos.)	4	0	0	0
28. Lower Chama River (Rio Arriba Co.)	14	0	0	3 red-tailed hawks 1 prairie falcon
29. Abiquiu Lake (Rio Arriba Co.)	3	0	0	0
30. Middle Chama River (Rio Arriba Co.)	12	4	1	0
31. El Vado Lake (Rio Arriba Co.)	11	2	3	0
32. Heron Lake (Rio Arriba Co.)	8	5	4	0
33. Brazos-adjacent Chama River (Rio Arriba Co.)	9	4	0	1 red-tailed hawk 1 Buteo sp.
34. Burford Lake (Rio Arriba Co.)	4	1	0	1 marsh hawk
35. Stone Lake (Rio Arriba Co.)	2	0	0	0
36. Embom Lake (Rio Arriba Co.)	1	2	0	0

*subadult

AREA	Survey Minutes	Bald Eagles Ad.	Bald Eagles Im.	Other Raptors
37. Horse Lake (Rio Arriba Co.)	1	0	0	0
38. "New" Lake (Rio Arriba Co.)	1	0	0	0
39. Dulce Lake (Rio Arriba Co.)	1	0	0	0
40. Navajo Lake (Rio Arriba-San Juan cos.)	69	7	6	1 dark eagle 1 red-tailed hawk 2 marsh hawks
41. Middle San Juan River (San Juan Co.)	20	1	0	2 red-tailed hawks 4 Buteo sp.
42. Animas River (San Juan Co.)	12	1	0	1 red-tailed hawk 1 Buteo sp.
43. La Plata River-Jackson Lake (San Juan Co.)	9	0	0	1 mi. golden eagle 1 red-tailed hawk 1 Buteo sp. 1 hawk
TOTALS	212	29	16	1 golden eagle 1 dark eagle 10 red-tailed hawks 8 Buteo sp. 3 marsh hawks 1 prairie falcon 1 hawk sp.
GRAND TOTALS	518	59	32	7 golden ealges 1 dark eagle 25 red-tailed hawks 7 rough-legged hawks 1 ferruginous hawk 1 Swainson(?) hawk 18 Buteo sp. 17 marsh hawks 2 prairie falcons 2 American kestrels 1 hawk 2 raptor sp.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LOS ALAMOS
SANTA FE
BERNALILLO
TORRANCE
GUADALUPE
DE BACA
CURRY
ROOSEV
VALENCIA
SOCORRO
CATRON
LINCOLN
ALBUQUERQUE
Grants
Española
LAS VEGAS
Tucumcari
Santa Rosa
Vaughn
Fort Sumner
Belen
Los Lunas
Socorro
Magdalena
Cuba
Springer
Cimarron
Clayton
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Mountainair
Carrizozo
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NORTHERN AND RIO GRANDE VALLEY, NEW MEXICO,
BALD EAGLE SURVEY (N.M.G.F.)
JANUARY 1979

NORTHWESTERN: 7:55 a.m. to 3:55 p.m., 23 January 1979 (see map).

Observers: Dick Brown (pilot), Keith Giezentanner, Mike Hatch

Weather: Clear to partly cloudy; cool to cold; moderate west wind; waters largely frozen on Chama and Jicarilla Reservation, otherwise mainly open; snow on ground, especially northward.

Survey Data: Cessna Skymaster, covering likely bald eagle areas at ca. 120 mph and 100 to 200 feet altitudes.

Area	Survey Minutes	Bald Eagles Ad.	Bald Eagles Im.	Other Raptors
1. Cochiti to Pena Blanca	8	2	4	1 redtail
2. Cochiti Lake	8	2	4	3 marsh hawks
3. Cochiti to Otowi	3	0	0	
4. Otowi to Espanola	7	1	0	
5. Espanola to Abiquiu Lake	20	0	0	1 redtail 1 Buteo
6. Abiquiu Lake	5	0	0	
7. Abiquiu Lake to El Vado Lake	15	3	4	
8. El Vado Lake	2	0	0	
9. Heron Lake	6	0	1	
10. Chama and Brazos Rivers	12	0	0	
11. Jicarilla Reservation Lakes	14	0	0	1 golden eagle
12. Navajo River	9	0	0	
13. Navajo River (Colo.)	2	0	0	
14. Navajo Lake-San Juan Area (Colo.)	6	4	4	1 prairie falcon 1 redtail
15. Navajo Lake-San Juan Area	41	13	14*	3 marsh hawks
16. Navajo Lake-Pine Area	11	4	1	
17. Navajo Lake to Bloomfield	14	3	0	3 redtails 1 Buteo 4 marsh hawks

Area		Survey Minutes	Bald Eagles Ad.	Bald Eagles Im.	Other Raptors
18.	Animas River	19	12	2	1 redtail
19.	Animas River to Durango (Colo.)	6	5	1	
20.	La Plata River	25	0	0	1 redtail 1 Buteo 1 marsh hawk
21.	Mouth La Plata River to Shiprock	12	1	0	1 redtail 1 marsh hawk
	TOTALS Colo.	14	9	5	
	N.M.	231	37	30	
	Combined	245	46	35	1 golden eagle 9 redtails 3 Buteo 12 marsh hawks 1 prairie falcon

MIDDLE RIO GRANDE VALLEY: 11:30 a.m. to 4:38 p.m. 24 January 1979 (see map)

Observers: Bruce Adams (pilot), Mike Hatch, John Hubbard

Weather: High thick overcast; cool to cold; light southwest wind; waters open, no snow on ground.

Survey Data: Helio Courier, covering likely bald eagle areas at 60-100 mph and 25-200 feet (mainly 100 feet) altitude.

Area		Survey Minutes	Bald Eagles Ad.	Bald Eagles Im.	Other Raptors
22.	Belen to La Joya S.G.R.	8	0	0	1 redtail 2 Buteo 2 marsh hawks
23.	La Joya S.G.R. area	6	0	0	1 marsh hawk
24.	Sevilleta N.W.R.	4	0	0	
25.	San Acacia to San Antonio	14	0	0	1 Buteo
26.	San Antonio to San Marcial	14			1 redtail 3 Buteo
27.	San Marcial to Elephant Butte Marsh	12	0	0	
28.	Elephant Butte Marsh	4	1	0	1 marsh hawk
29.	Elephant Butte Narrows	5	0	0	

Area	Survey Minutes	Bald Eagles Ad.	Bald Eagles Im.	Other Raptors
30. Elephant Butte Lake	46	4	5	1 dark eagle 2 redtails 1 roughleg 2 Buteo 10 marsh hawks
31. Williamsburg to Caballo Lake	6	0	0	2 marsh hawks
32. Caballo Lake	22	5	13	1 golden eagle 2 dark eagles 1 redtail 1 Buteo 1 marsh hawk
33. Caballo Lake to Percha Dam	3	0	0	
TOTALS	144	10	18	1 golden eagle 3 dark eagles 5 redtails 1 roughleg 9 Buteo 17 marsh hawks

NORTHEASTERN: 9:45 a.m. to 5:35 p.m., 27 January 1979 (see map)

Observers: Bruce Adams (pilot), Mike Hatch, John Hubbard

Weather: Clear to partly cloudy (some ground "fog" early in day); cool to cold; moderate west wind; waters open on Pecos and Canadian and mainly frozen Raton to Las Vegas, snow on ground in most areas.

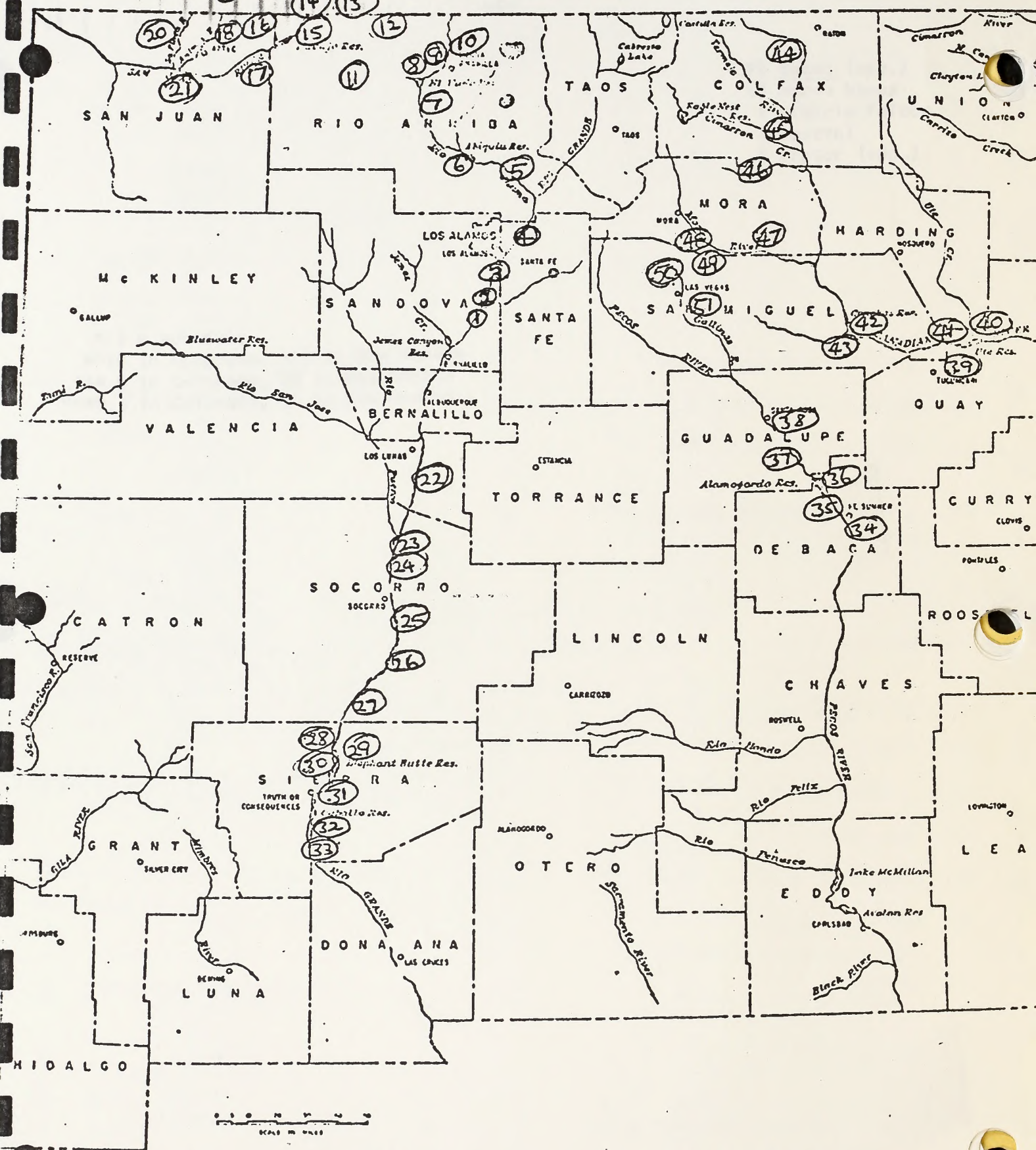
Survey Data: Helio Courier, covering likely bald eagle area at 60-75 mph and 25-200 feet altitude.

Area	Survey Minutes	Bald Eagles Ad.	Bald Eagles Im.	Other Raptors
34. Pecos below Ft. Sumner	22	1	2	2 golden eagles 5 redtails 1 raptor
35. Ft. Sumner to Sumner Lake	11	0	1	1 golden eagle 2 redtails 1 Buteo 2 marsh hawks
36. Sumner Lake	15	6	13	1 golden eagle 1 redtail 2 marsh hawks

Area		Survey Minutes	Bald Eagles Ad.	Bald Eagles Im.	Other Raptors
37.	Sumner Lake to Puerto de Luna	12	7	2	2 golden eagles 1 Buteo
38.	Puerto de Luna to Santa Rosa	12	1	1	1 redtail 3 Buteo 1 marsh hawk
39.	Tucumcari Lake	2	0	0	2 marsh hawks
40.	Ute Lake	28	7	9*	2 golden eagles 8 marsh hawks
41.	Ute Lake up Canadian River	10	0	1	1 Buteo
42.	Conchas Lake (Canadian Arm)	17	11	10	1 raptor
43.	Conchas Lake (Conchas Arm)	8	5	0	1 redtail 1 Buteo
44.	Maxwell Lakes NWR and French Lakes area	13	4	5	7 golden eagles 1 redtail 2 Buteo 4 marsh hawks 1 kestrel
45.	Springer area	6	0	0	1 golden eagle 2 roughlegs
46.	Charette Lakes	3	0	0	
47.	Cherry Lake	5	4	2	
48.	La Cueva S.G.R.	3	1	0	
49.	York Lakes	1	0	0	
50.	Storrie Lake	2	0	0	
51.	Las Vegas N.W.R.	3	0	0	1 Buteo
	TOTALS	140	49	46	16 golden eagles 11 redtails 2 roughlegs 10 Buteo 19 marsh hawks 1 kestrel 2 raptors
	GRAND TOTALS	529**	105***	99****	18 golden eagles 3 dark eagles 25 redtails 3 roughlegs

22 Buteo (spp.)
48 marsh hawks
1 prairie falcon
1 kestrel
2 raptor (spp.)

* 1 a subadult
**14 in Colorado, 515 in New Mexico
*** 9 in Colorado, 99 in New Mexico
**** 5 in Colorado, 94 in New Mexico



Bufo b. boreas

NESTING ACTIVITY

Animas River, Colorado

This nest site, located about 10 miles south of Durango, was originally to be monitored as an extension of the Navajo Lake winter eagle study because of its proximity to that area. However, the Colorado Division of Wildlife assumed physical and financial responsibility for monitoring the site, while the RMS cooperated by checking activity from the air on 21 March 1979. Most of the following information was provided through the courtesy of Jerry Craig, Raptor Biologist, Colorado Division of Wildlife (pers. comm.).

There were originally two nests 50-100 yards apart in this territory, but only one remained in 1979. At 1100 on 21 March a single adult was perched in the nest tree several feet from the nest. There was no sign of another adult or nesting activity. The nest tree is a live, healthy ponderosa pine situated on the west side of the first ridge west of the river. The area is predominantly pinyon-juniper, with a few scattered ponderosa.

A helicopter pilot observed two adults during the first week of April, but no birds were seen on two subsequent checks on 18 and 28 April. The pilot, who had flown the 21 March flight, saw one adult "on" the nest and the other perched nearby. One lone bird was seen intermittently on 16 days through May in the nest area and at a small lake up river. Most observations were between 1030 and 1430. A cottonwood on the east bank of the Animas was frequently used for perching, while the adult was seen at least three times flying from trees near the nest. Some fresh greenery appeared on the nest and a few castings and prey remains (catfish) were found below, but no other activity was noted.

Centerfire Bog, New Mexico

Bill Luckett's contractual report on this site follows. He was stationed at Centerfire from 21 April through 4 May 1979. This nest was first discovered in mid-March (John Hubbard, New Mexico Department of Game and Fish, pers. comm.), and was apparently constructed since January when a CDRI team was in the area. The site was again checked by CDRI personnel on 31 March and 1 April. The results of those observations are presented in the Gila report (p. 58, photos 16 and 17).

The reason for the nest failure at Centerfire Bog cannot be determined. This was a pioneering situation and as such, may have involved inexperienced nesters or resulted in unusual stress from the new surroundings. Similarly, the apparent cannabolism of the young may be an expression of stress and/or inexperience, or the young may have already been dead. The only certainty is that egg shell fragments of apparently normal thickness and with no evidence of amnionic membrane attachment were collected from the nest. The casting material with the down and partial foot found near the nest has been sent to the Smithsonian Museum for positive identification. Other items collected at the nest site included part of an elk leg bone and a gadwall wing; while evidence of lagomorphs, coots, and unidentified waterfowl was found separately and in the casting material.

The Centerfire nest site (shown in Figures 1,2) remains in Pat Jenks' ownership, as an inholding within the Gila National Forest. However, he has removed his cattle from the bog area, modified a fence that was hazardous to low flying eagles hunting over the bog, and worked with the USFS to limit or prohibit access to the area around the nest site itself. Future nesting efforts will be monitored by the caretaker at the Bog and by the state and federal agencies involved.

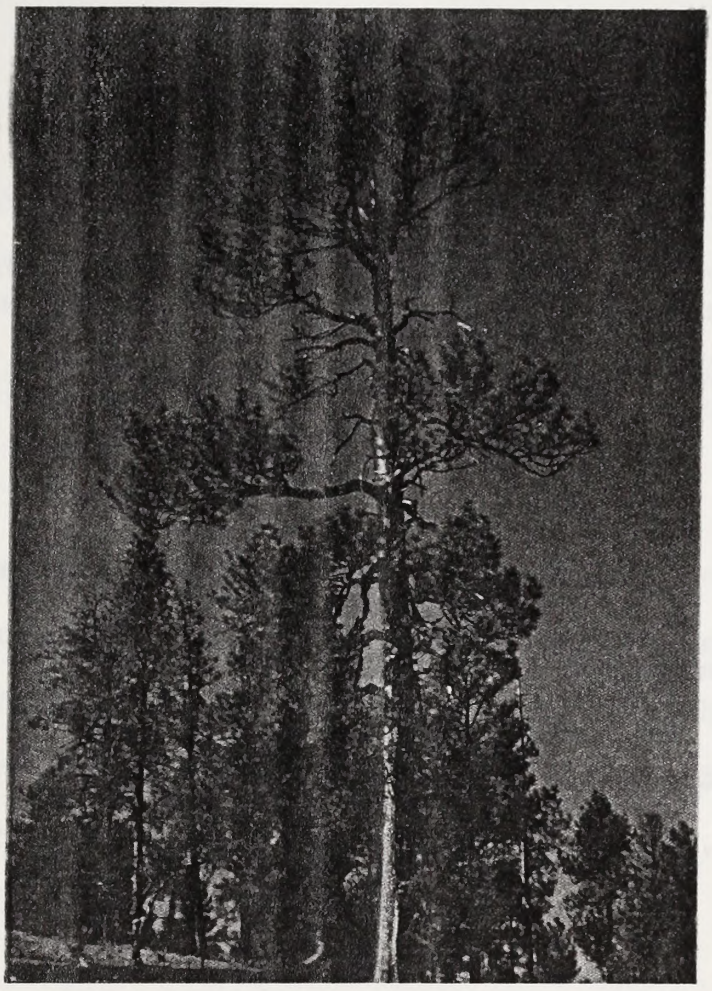


Figure 1 - Ponderosa pine nest tree at Centerfire Bog.

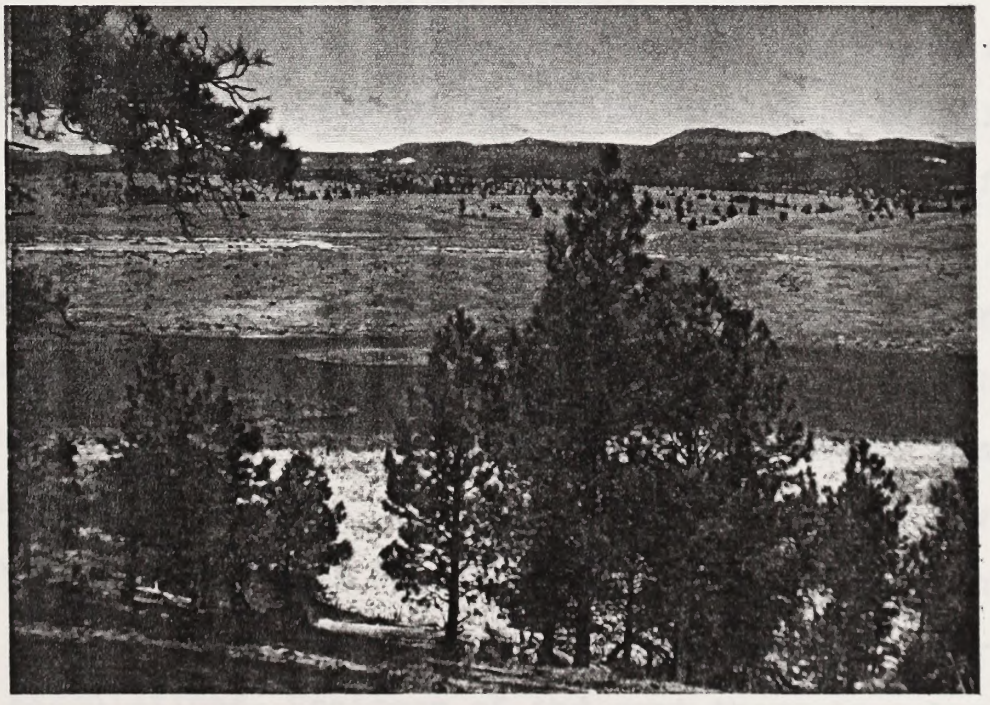


Figure 2 - Centerfire Bog viewed from the nest tree.

BALD EAGLE NEST SURVEILLANCE

CENTERFIRE BOG

GILA NATIONAL FOREST

Prepared for:

Rocky Mountain Forest and Range Experiment Station

Forestry Sciences Laboratory

Arizona State University

Tempe, Arizona 85281

By:

Bill Luckett

Contract Biologist

Tempe, Arizona

June 1979

Research Agreement No. 53-82FT-9-99

Name: Centerfire Bog

Place: Catron County
New Mexico

Location: T4S R19W Sec 5
T5S R19W Sec 32
T5S R19W Sec 33

Ownership: Mr. Randolph Jenks

summer: P.O. Box 80
Luna, N.M. 87824

winter: 2146 E. 4th St.
Tucson, Az 85719

The Centerfire Bog is a natural spring fed cienga situated south of Spur Lake Basin in the Mogollon Highlands (Map 1). The bog is the headwaters of Centerfire Creek which drains southwest to join with S.A. Creek as a tributary to the San Francisco River. The San Francisco flows eastward at that point, following a path around the San Francisco Mountains.

General Ecology:

This area can best be described a montane highlands with a ponderosa pine-rabbitbush savannah association with scattered pinyon-juniper stringers to the north and a ponderosa pine-gambels oak association along the ridges to the south. The mixed broadleaf community scattered along riparian areas include narrowleaf cottonwood associations.

Centerfire Bog (Map 2) is a gently sloping drainage approximately 3/4 of a mile long and varies from 50 to 500 ft. wide. In the past, a low earthen dike was constructed creating a permanent pond as a stock tank at the lower end of the bog (Plate 1). Aquatic vegetation within the pond was largely pondweed and smartweed. Emergent vegetation of this marsh provided areas of sedge, cattail, bulrush and spikerush associations. Upstream of the pond there is a large sedge

meadow which grades into a grassy meadow mixed with rabbitbush. A variety of grasses, forbs, and sedges were found along the borders of the bog.

The upland area to the north was mostly rabbitbush with scattered ponderosa pine. To the south, vegetation was mostly stringers of various sizes of ponderosa pine.

Historically, Centerfire Bog has been subject to grazing pressures, as indicated by the invasion of rabbitbush in the grassy floodplain around the bog (Stechman, 1977). This undoubtedly has acted to reduce overall habitat quality (Plate 2&3). The swampy nature of the bog however, has given some natural protection to the emergent vegetation and does support a variety of wetland avian species. Of the 46 species of birds observed during the investigation, 15 (33%) were wetland species (Appendix). Previous historical observations list some 73 species, of which 29 (40%) were wetland species (N.M.Aud.S.).

The wetland productivity has contributed to the attractiveness to many other species as well. The most notable of these being the nesting bald eagles during 1979. Availability of large ponderosa pine snags also add to the attractiveness by serving as nesting structures (Scott and Patton, 1975) and perches for a variety of birds.

Mammalian ecology of this area, while not as visable as the avian, was also quite diverse. Mr. Jenks claims there is a unique subspecies of meadow vole present which is endemic to the bog. Given the probpleistocene origin of the bog and its isolation from similar habitat, that is a distinct possibility of being true. Other mammals observed are also listed in the appendix.

Bald Eagle Nest Site: Map 3

Loacation: T6N R19W Sec 33 SW¼ SW¼

Vegetation: Montane coniferous forest Elevation: 7240'(2207M)

Nest structure: Stick platform in the crown of ponderosa pine live cull (Plate 3&4).

tree height: 76'(23M) dbh: 31.6"(80.2cm) nest height: 67'(20.4M)

Terrain: Rolling hills and meadows draining to a mountain bog

slope at nest: 20 aspect at nest: NW 335

Water: Approximately 200yds. (183M) to Centerfire Bog.

Territories: nesting approx. .8-1 sq. mi.
hunting approx. 210-250 sq. mi.

Bald Eagle Nesting Summary:

During the two weeks from 4-21-79 to 5-4-79 approximately 130 observation hours were made of the bald eagles at Centerfire Bog. About 97% of these were made from the porch of a cabin approximately 3/4 of a mile from the nest site.

The eagles were apparently brooding eggs until 4-23 when close sitting behavior was observed. Feeding of young was first observed on 4-24. This would place egg laying about 3-19. The adults shared incubation duties, with the male relieving the female from about 0900 until 1100 every day. After hatching the male spent very little time at the nest spending most of his time away from the nest site. The eagles fed twice a day, morning and late afternoon except the brief period they were caring for the young. Then they would feed 4 times a day. These feedings were at approximately 3 hour intervals starting at 0900. Observations included 16 prey items brought to the nest. Of

these, 37.5% were waterfowl, 18.7% small mammals, 6.3% fish and 37.5% were unidentified. The male brought 75% of the prey to the nest and the female 25%.

On 4-27 the female was observed to devour one of her eaglets. A casting found beneath perch A on 5-3 consisted of white down and contained a young rapter talon (Plate 5). There had been some slight disturbance by myself and a ranch hand on 4-26. The male disappeared during the intrusion and did not return for nearly 24 hours. It was during his absence when the female apparently cannabilized her young. The birds reacted to intrusion within ½ mile of their eyrie by sounding alarm and within ¼mile by circling the area. It is my opinion that our intrusion may have caused the disappearance of the male bird. This absence may have triggered some type of psychological stress in the female causing the abnormal cannablism. This sensitivity and tragic response could have several explanations or a combination of them all.

First, this was the first nesting attempt at Centerfire and possibly the first breeding attempt for this pioneering pair of birds. Second, their intolerance to human intrusion could have explained the remoteness of the nesting site (Call, 1978). And their reaction a response to increased human activity later during the spring. Finally, other factors such as sonic booms and low flying jet fighters could have had the eagles under stress (Plate 6). The male eagle would often soar to extremely high altitudes (over 12,000') and was observed over 8 miles from the nest site. It is probable that his territory covered the entire area from the San Francisco Mountains northward to Black Peak and

Bill Knight Gap (Map 1). Observations after a sonic boom showed the male was visibly disturbed.

On 4-28 the male was observed adding a stick to the nest and the eagles were observed copulating but very little nesting interest was displayed after that date.

Political Status:

Centerfire Bog was purchsed by Mr. Jenks in 1977. He is a rancher-biologist who homesteaded in Tucson, Arizona during the 1930's and is listed as a contributor of Peterson's Field Guide to Western Birds. He is a member of the Natue Conservancy conservation committee in Tucson. Centerfire Bog had caught the attention of Sierra Club, the New Mexico Audubon Society and the Nature Conservancy as a place they believed warranted preservation. When this property was offered for sale and the Conservancy balked at its purchase, Mr. Jenks bought it to keep it from falling into unappreciative hands. Presently he must utilize a cattle operation on the property to meet his financial commitments but his ultimate goal is to see Centerfire a sanctuary for wildlife.

He has written Mr. Olsen of the New Mexico Game and Fish Department and asked that the state reinstitute the former game refuge status abolished in the 1950's. Mr. Olsen essentually stated by letter that he couldn't consider this as long as the cattle operations were being conducted. Mr. Jenks has also contacted the U.S.F.&W.S. and asked that the land be purchased as a wildlife refuge. The Department of the Interior clearly has such authority under the Migratory Bird Con-

servation Act of 1929, the Fish and Wildlife Coordination Act of 1970, the Fish and Wildlife Act of 1956, and the Endangered Species Acts of 1966,1969 and 1973 (Anon. 1977)

Mr. Jenks clearly believes that Centerfire should be preserved and not hunted. He is receptive to the idea of leasing Centerfire as a means of removing the cattle, either to a private preservation concern or to the U.S. government. The Department of Agriculture has such authority under the Water Bank Act of 1970 (Anon. 1977)

The response from U.S.F.&W.S. was that Centerfire Bog was listed on a Class II list and that they were concerned primarily with acquiring Class I properties.

Mr. Jenks has also proposed that the U.S. Forest Service swap him 40 acres for 40 acres as a means of greater protection of the bog. That decision is still pending but Mr. Jenks said that the Forest Service thinks the deal is too small, but he hopes they'll accept his proposal (Map 4).

Management Recommendations:

After Mr. Jenks purchased the Centerfire Bog property he fenced it, built a cabin and acquired a caretaker to restrict access to prevent poaching and disturbance of nesting birds. The end result has cummulated with a pair of bald eagles selecting this area as a nesting site. This being the only recent record for New Mexico and southwestern montane coniferous forests, is of extreme importance if our recovery efforts are to be successful. What is learned here could have widespread implications across southwestern forests. Perhaps providing key insig-

to the potentials of developing an alternate nesting population to our bald eagles along riparian habitats.

A variety of management options are available and seem feasible. Any management options selected will require cooperation of the New Mexico Game and Fish Department, the U.S. Forest Service the U.S. Fish and Wildlife Service and Mr. Jenks. The worst option available would be inaction as this area warrants special considerations and could easily become a political hassle between environmental concerns and governmental agencies.

In the short term, action should be taken toward the definition of critical habitat and adequate protection of the bog. The land exchange appears advisable. First to facilitate protection of the area should the eagles return in 1980. This would allow protection without resorting to a forest closure. Secondly, this would remove a barbed wire fence, which extending into the bog, poses a hazard to large rapters after prey. This is especially true for younger birds learning to fly.

Efforts should be initiated to reroute the military training flights over the area. Should the eagles return, it would eliminate a potential stress factor. This buffer strip should extend for a radius of 10 miles from the nest, some 315 square miles. Given the historical character of nesting eagles, a reduction of possible stress factors may result in nesting success.

The ideal long term solution would appear to be federal aquisition of Centerfire Bog as a wildlife refuge. Such policy would demonstrate governmental efficiency to environmental conservation concerns. It

would also allow the preservation of the bog and three miles of riparian habitat. The elimination of grazing would permit restoration to a near pristene situation and would undoubtedly increase the wildlife productivity and available prey base for the nesting eagles. The ideal refuge would include not only the present property but an additional 120 acres under Forest Service administration to protect the watershed (Map 5). This would, however, call for a change in federal status from Class II priority to Class I.

Often situations are less than ideal. Alternate solutions which would have much the same effect could be possible private acquisition by conservation organizations. The leasing of Centerfire by either private or governmental agencies would also serve to eliminate the grazing of this wetland. Mr. Jenks has set a price of $10,000 a year on the leasing idea.

Regardless of the polices chosen, it has been demonstrated by Mr. Jenks that this area is unique in character and deserving of special management effort. I advised Mr. Jenks to have patience and allow governmental process a chance to re-evaluate the situation and management options before applying more political pressures to attain his goal that Centerfire Bog become a wildlife sanctuary.

submitted by:

Bill Luckett

May 20, 1979

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Appendix An Index To Scientific Names

Dominant plant species observed

pondweed	*Potamogeton sp.*
smartweed	*Polygonum amphibium*
sedges	*Carex sp.*
cattail	*Typha sp.*
bulrush	*Scirpus sp.*
spikerush	*Eleocharis sp.*
rabbitbush	*Chrysathamnus sp.*
ponderosa pine	*Pinus ponderosa*
gambel oak	*Quercus gambeli*
juniper	*Juniperus monosperma*
pinyon	*Pinus edulis*
narrowleaf cottonwood	*Populus angustifolia*

Birds observed

bald eagles	*Haliaeetus leucocephalus*
shoveler	*Spatula elypeata*
mallard	*Anas platyrhynchos*
ruddy duck	*Oxyura jamaicensis*
blue-winged teal	*Anas discors*
cinnimon teal	*Anas cyanoptera*
ringneck duck	*Aythya collaris*
American widgeon	*Mareca americana*
pied-billed grebe	*Podilymbus podiceps*
American coot	*Fulica americana*

Birds observed cont.

mountain bluebird	Sialia currucoides
western bluebird	Sialia mexicana
robin	Turdus migrtorius
raven	Corvus corax
crow	Corvus brachyrhynchos
redtailed hawk	Buteo jamaciensis
purple martin	Progne subis
violet-green swallow	Tachycineta thalassina
rough-winged swallow	Stelgidopterix ruficollis
cliff swallow	Petrochelidon pyrrhonota
redwing blackbird	Agelaius phoeniceus
Brewer's blackbird	Euphagus cyanocephalus
yellowheaded blackbird	Xanthocephalus xanthocephalus
American kestrel	Falco sparverius
mourning dove	Zenaidura macroura
brown towhee	Pipilo fuscus
Say's phoebe	Sayornis saya
rock wren	Salpinctes obsoletus
long-billed marsh wren	Thelmatodytes palustris
great horned owl	Bubo virginianus
killdeer	Charadrius vociferus
red-shafted flicker	Colaptes cafer
pinyon jay	Gymnorhinus cyanocephalus
Steller's jay	Cyanocitta stelleri
turkey	Melagris gallopavo
turkey vulture	Cathartes aura

Birds observed cont.

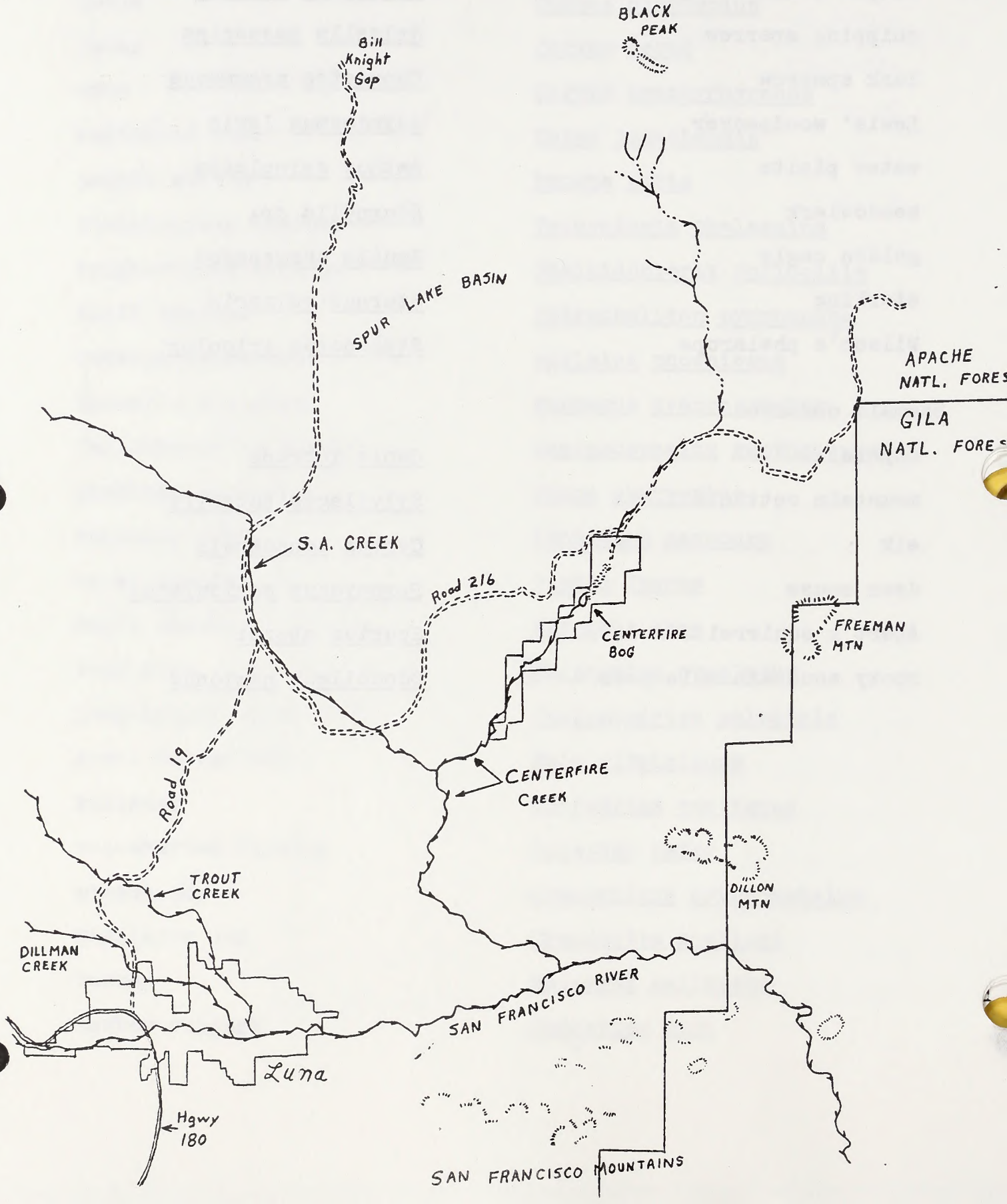
mountain chickadee	Parus gambeli
Cooper's hawk	Accipiter cooperi
chipping sparrow	Spizella passerina
lark sparrow	Chondetes grammacus
Lewis' woodpecker	Asyndesmus lewis
water pipits	Anthus spinoletta
meadowlark	Sturnella sp.
golden eagle	Aguila chrysaetos
starling	Sturnus vulgaris
Wilson's phalarope	Steganopus tricolor

Mammals observed

coyote	Canis latrans
mountain cottontail	Sylvilagus nuttalli
elk	Cervus canadensis
deer mouse	Peromyscus maniculatus
Abert's squirrel	Scurius aberti
rocky mountain mule deer	Odocoileus hemionus

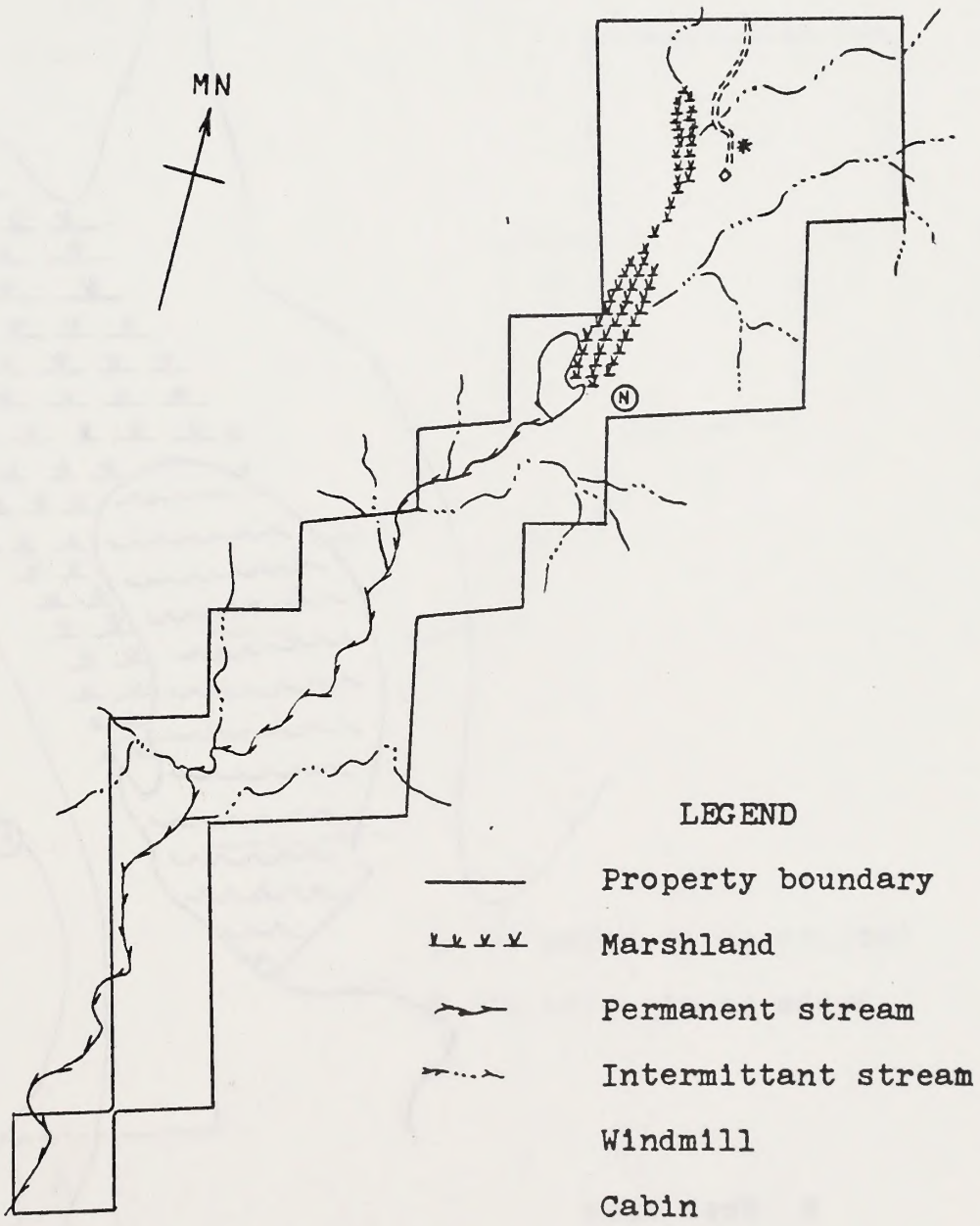
MAP 1 CENTERFIRE BOG AND SURROUNDING AREA

½" = 1 mile



MAP 2 CENTERFIRE BOG PROPERTY

2" = 1 mile



MAP 3 CENTERFIRE EAGLE NESTING AREA

N Nest tree

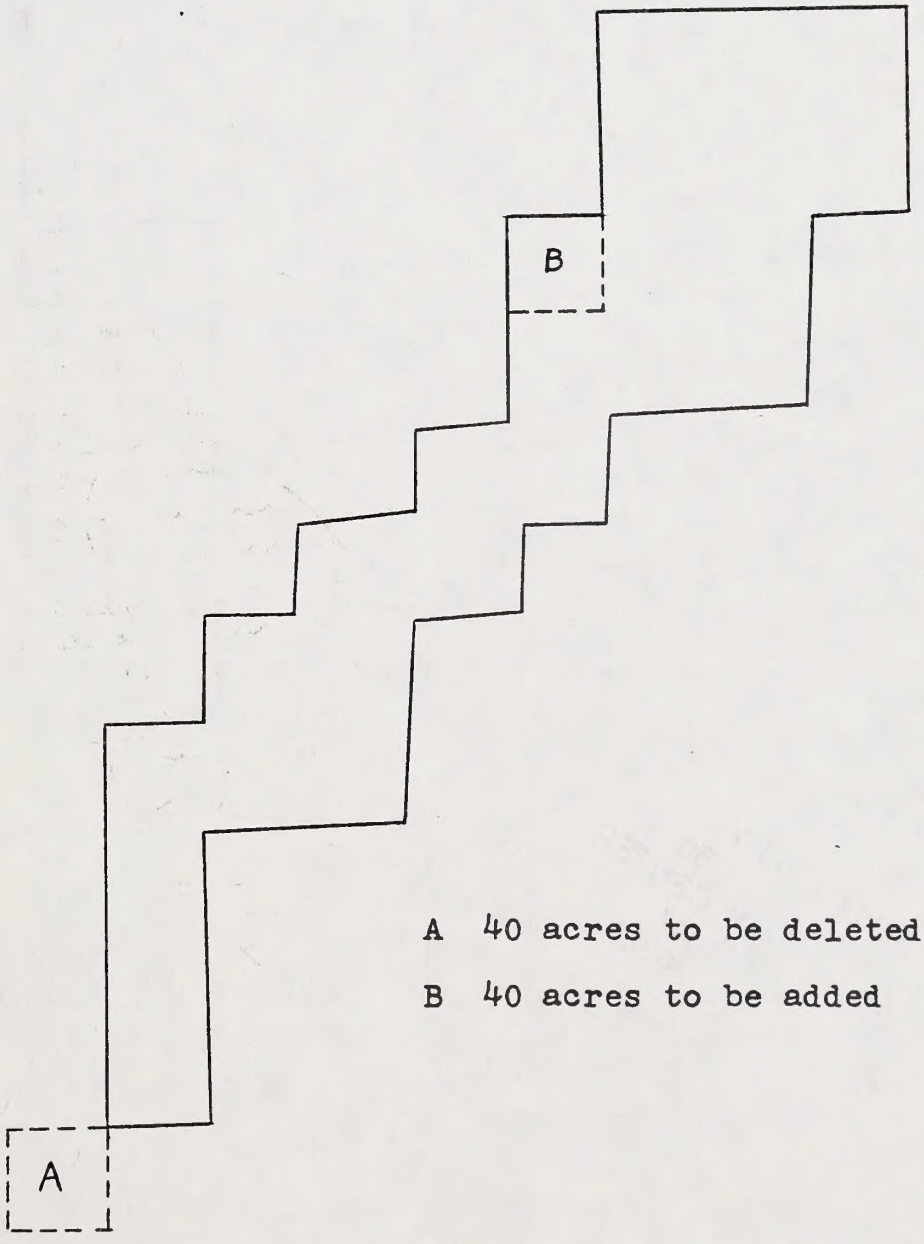
A 65' ponderosa snag dbh 31.1"

B 52' p. pine dbh 22.4"

C 55' p. pine spiketop dbh 21.3"

R Thick p. pine roost area

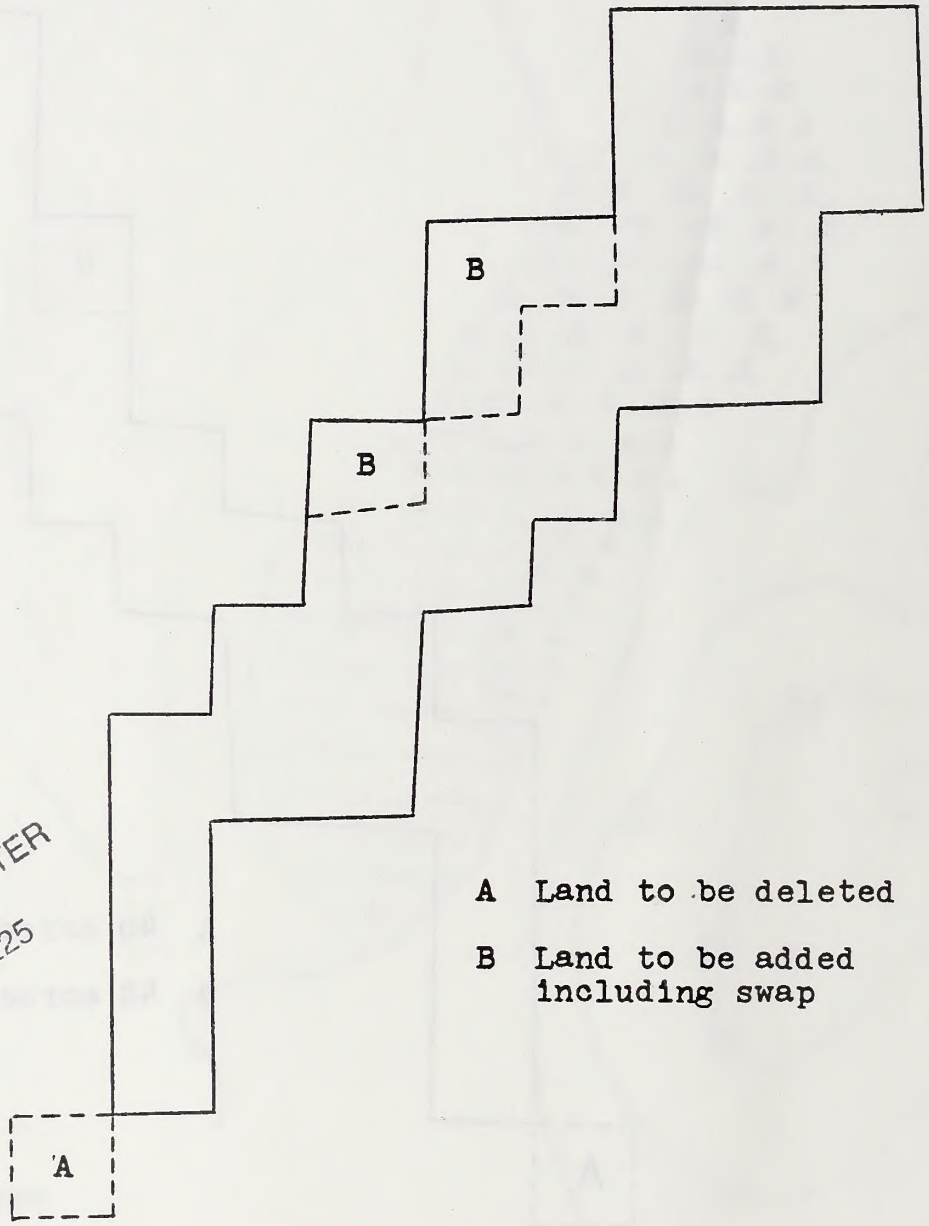
MAP 4 PROPOSED LAND SWAP OF MR JENKS



A 40 acres to be deleted

B 40 acres to be added

MAP 5 IDEAL REFUGE BOUNDARIES



A Land to be deleted

B Land to be added including swap

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